Compressed Air Magazine

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TESTING AN OIL WELL FOR GAS LIFT

ON THE COVER

OUR cover picture shows a high-pressure portable compressor in the Rodessa Oil Field of Louisiana. It is used to conduct tests on the flowing characteristics of wells by the gas-lift method preparatory to installing permanent compressor plants. This machine is driven by an Ingersoll-Rand Type "H" oil engine, and is equipped with special compressor cylinders to meet the needs of the service. It will deliver 1,000 pounds starting pressure and 500 pounds operating pressure. The photograph was taken by Richard T. Jackson.

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IN THIS ISSUE

ORDINARILY, we think of diesel power as a substitute for steam or some other form of prime mover. In many instances, however, a diesel engine can be advantageously used to supplement, rather than to supplant, other means of developing power. In the case of the Hinsdale Paper Manufacturing Company, steam, electricity, and a diesel engine form an economical trinity.

●

MOST of compressed air's numerous services to mankind are of an impersonal nature. Occasionally, however, when we visit the dentist, for example, we come into intimate contact with it. Then it becomes a tormentor rather than a benefactor, and we naturally stamp it as somewhat of a villain. And, as though to agree with us, the air supplies the hiss. Modern doctors and dentists use compressed air in many ways, as described in this issue.

●

TO DETERMINE with accuracy how deep a pipe line lies beneath the surface of a watercourse that it crosses, obviously is somewhat of a problem, particularly if the line is buried. But engineers for two pipe-line companies in Texas devised an ingenious method of ascertaining the depth with the aid of compressed air, as herein described and illustrated.

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DISTANT places appeal to all of us. Armchair travelers may get a vicarious glimpse of Turkey from Frank A. Ashby's article in this issue in which he sets down some of his impressions of that country while traveling as a representative of an American mining-machinery manufacturer.

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THERE will be two world fairs in 1939—one in New York and the other in San Francisco. The one on the West Coast will be held on an island that was reclaimed from the bay. As described in this issue. After the exposition it will serve as a municipal airport.

Compressed Air Magazine

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EDITORIAL CONTENTS

ADVERTISING INDEX

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Air Service in

THE ATOMIZER

The dentist's atomizer (above) is operated with compressed air obtained by connecting it with the office line, the pressure being lowered to the desired point by the use of a reduction valve. Hypodermic needles range in size from 18 gauge, approximately as large as a small pencil lead, down to 27 gauge, which is about the thickness of a fine sewing needle. The holes through them, some as small as a fine hair, must be thoroughly dried after sterilization lest moisture cause rust and thus clog them. The approved method of doing this is with a jet of air, as shown at the top-right.

USING NASAL SPRAY

A compressed-air-operated atomizer being used with the aid of a patented nose holder, of which no one seems to know the name. Each tenant provides his own regulator, and this permits him to raise and to lower the pressure within the prescribed limits as occasion may require. One of them is shown at the left-center near the patient's shoulder.

ONCE upon a time the dentist murmured in your ear: "Tell me if this hurts, please," and then blasted the frazzled ends of your nerve system with a jet of air of such force, apparently, as to have come out of the mouth of an airplane test tunnel. At the moment you possibly did not know, nor care to know, that down in the basement, or up in the penthouse of the building in which he had his office, a compressor was leisurely producing the air that was the cause of your discomfort.

Furthermore, if the incident took place in one of those buildings devoted exclusively to the medical, dental, and allied arts, of which most major cities boast at least one, compressed air in minute but effective quantities was at the same time hissing in countless other offices and in laboratories from the bottom floor to the top. Its various accomplishments in such a structure include blowing out tooth cavities, noses, and throats; nebulizing medicaments in the vicinity of a patient; applying pressure to gas blowpipes used in casting and brazing somebody's new teeth and gums; blowing through hair-sized holes in hypodermic needles to dry them after sterilization; forcing vaporized ether into unwilling nostrils preparatory to nose, throat, and oral surgery; and in more serious operations, for all the patient will ever know, perhaps blowing air into his innermost in-

edical Building

Henry W. Young

ADMINISTERING ANAESTHETIC

The nurse at the left (above) is about to transport a patient to dreamland. The three bottles in the center of the picture contain, respectively, ether, chloroform, and water. By means of air pressure, controlled by a valve, either ether or chloroform vapor is forced through the water to render it less irritating, and is then administered. Chloroform is now seldom used.

MAKING DENTURES

Typical compressed-air service for a dental laboratory, showing an expert (left) using a Torit No. 4 blowpipe that receives its supply from the low-pressure building line.

sides. Incidentally it does maintenance work.

An air-compressor plant having a capacity of 30 to 40 cubic feet of free air per minute is nothing to write home about, in point of size. But when the output is employed in such personal ways as just mentioned, the whole thing takes on a certain measure of human interest. It was with this in mind that a little camera journey was made through the Medical Arts Building of Portland, Oreg. The professional men visited in taking the pictures entered wholeheartedly into the spirit of the undertaking. Men so high in the medical world that their names are mentioned with profound respect, insisted on looking into the view finder and helping to pose the subjects. It would have been a pleasure to have some of them in the photographs; but that would have been unethical from their standpoint. Therefore nurses, for the time being, acted as doctors and patients, with pictorial results that may be observed in the accompanying illustrations.

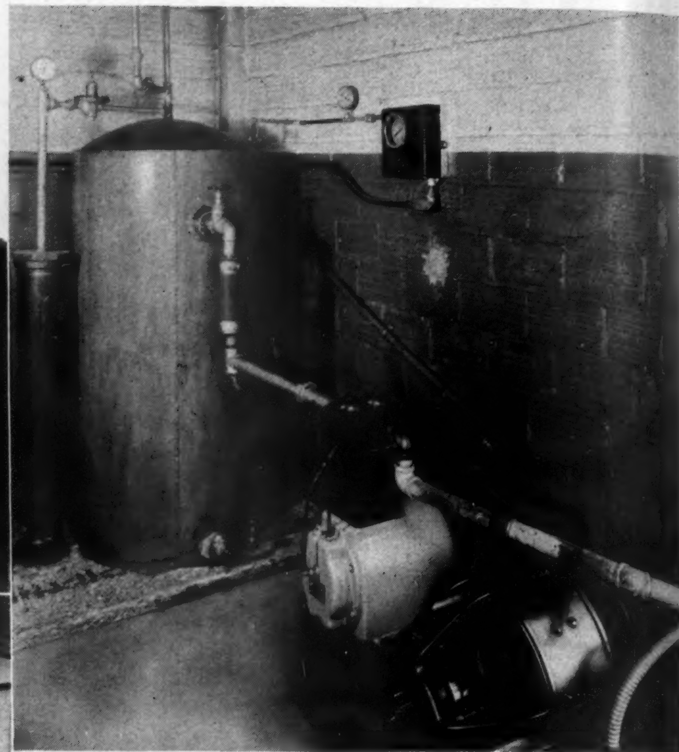
The Medical Arts Building is a Class A structure eight stories high with a three-quarter basement, and has ground dimensions of 100x200 feet. It is occupied wholly by doctors of medicine and dentistry, X-ray treatment departments, surgery rooms, etc. The suites of the professional men are cut up into a great many small compartments for examination and treatment—much smaller than those in the average office building. To each of these suites, and to most of the individual rooms in them, compressed air is delivered by the building management through a special network of pipes and at 35 pounds constant pressure. The tenant installs his own regulators to reduce the pressure to meet his particular needs. Always, however, he is assured of that constant 35 pounds at the point of entry. There must never be any jumpy or intermittent service in connection with the operation of the compressed-air system because, if permitted, it might well lead to serious situations.

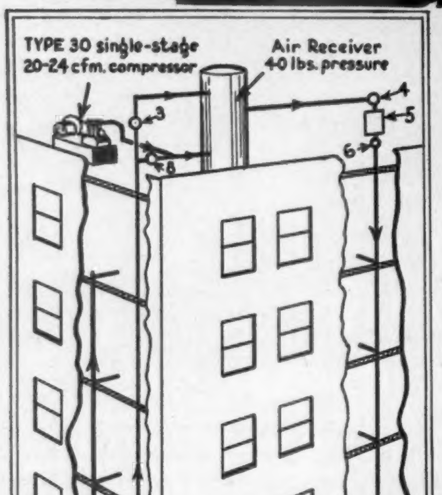
A building of this sort requires two distinct types of air service, each with its own transmission system. A high-pressure line, which contributes in various ways to the operation and maintenance of the structure itself, and a lower-pressure and more carefully regulated one for the use of the tenants. The system as a whole must have considerable flexibility. In this case it was attained a few years ago by substituting two modern compressors for an old-style, belt-driven, 40-cfm. machine which had been in service since the building was erected.

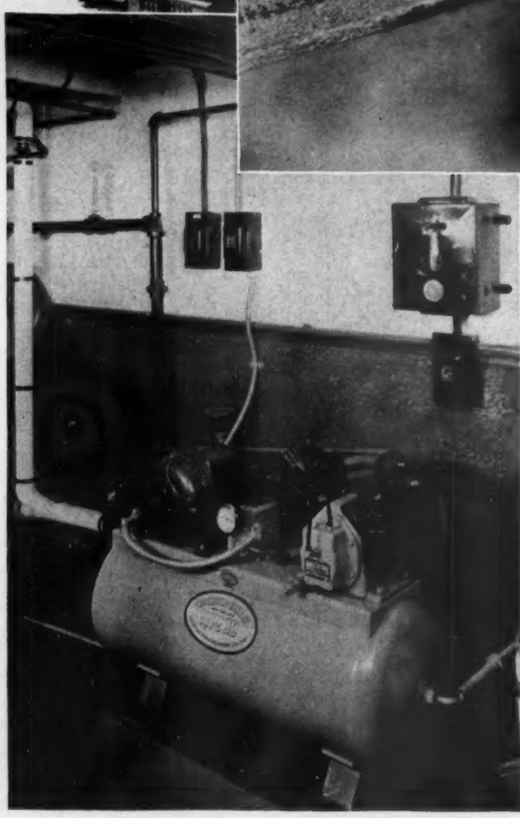
A full automatic system was decided upon. It was to be as simple in its operation as possible. There is no power plant in the structure: no boiler plant for heating, even, since steam is bought from a central utility heating plant. Therefore, there is no operating engineering department, such as is in many other large buildings, to look after the compressed-air system. The accompanying sketch shows how the plant was connected in order to assure simplicity and reliability of operation with as little attention as practicable. In some respects it differs from the average run of installations.

Both compressors are Ingersoll-Rand air-cooled, Type 30 units. They are driven through V-belts by motors mounted with them on the same structural base. Machines of this sort are widely used for garage and industrial purposes. The high-pressure compressor is located in the basement. It is of 2-stage design, with cylinders of 5- and 3-inch bore and of 3½-inch stroke. It has a capacity of 24 cfm. and is driven by a 5-hp. motor. This unit discharges into a basement receiver in which the air is maintained at 90 pounds pressure. The air lines for the building service on the different floors are connected directly to this basement tank.

A separate line extends from the basement receiver to a second tank in the penthouse, the air passing through a high-pressure reducing valve and being kept at 40 pounds pressure. It is from this penthouse receiver that the air for the tenants' use is







THE TWO COMPRESSORS

There is need in the building for two compressed-air systems—one for ordinary building operations and maintenance, and another for the doctors and dentists that occupy the structure. Accordingly, two compressors are installed: a 2-stage unit (left) that discharges at 90 pounds pressure and is located in the basement, and a single-stage machine (above) that discharges at 40 pounds pressure and is set up in the penthouse. The two systems are interconnected so that either can take care of all the needs in case of an emergency.

AIR-SYSTEM DETAILS

The sketch shows how the two compressed-air systems have been linked together to provide a flexible, reliable, and economical plant. The basement compressor furnishes air at 90 pounds pressure for ordinary building maintenance through line (1), which has take-offs on each floor. It is also connected with the penthouse receiver by line (2). By means of valve (3) the pressure is reduced to 40 pounds. The line that supplies the doctors and dentists taps the penthouse receiver, the pressure being reduced by valve (4) and expansion chamber (5) so that gauge (6) always indicates exactly 35 pounds. This tenants' line (7) has take-offs on each floor, with numerous branches leading to the various suites where valves reduce the pressure as desired for the different services. The discharge line from the penthouse compressor is connected with the high-pressure line (2) by a by-pass on which is the check valve (8). Ordinarily, when there is need for both 90-pound and 35-pound air, the basement unit only is operated, but if there is an emergency, and additional air is demanded, the penthouse machine cuts in automatically. The latter also can carry the entire load, if necessary. On Sundays, holidays, and at other times when there is no call for 90-pound air, the basement compressor is shut down and the penthouse unit supplies the tenants. At the top-left is a picture of the Medical Arts Building in which this system is installed.

AIR FOR BUILDING MAINTENANCE

Supt. George A. Hanscome (left) demonstrates how a jet of air is used for cleaning the contacts of the elevator electrical system. The maintenance force is called upon not only to do ordinary flat painting but also to touch up furniture, cabinets, and other equipment. For the latter purpose the spray gun (above) is an indispensable appliance.

taken, but it first goes through a reducing valve and an expansion tank by means of which it is regulated so as to assure at all times the constant 35-pound pressure that is required.

The second compressor is set up in the penthouse and is a relief unit. It is a single-stage machine that has a capacity of 20 to 24 cfm. at 40 to 60 pounds pressure. It discharges directly into the receiver in the penthouse.

Between the line from the penthouse compressor and the line from the basement installation (ahead of the reducing valve in the latter case) a by-pass with a ball check valve has been inserted so that it is possible for the penthouse compressor to deliver air to the basement receiver when the basement machine is not running for one reason or another.

With the two compressor units and the two systems thus connected, several objectives are attained. The two compressors can be operated regularly at the same time if extra air is needed, although so far this has not been necessary. The high-pressure but lower-capacity basement unit takes care of all the ordinary requirements of the building for both 90-pound and 35-pound air. If there is an emergency demand for more air than the basement machine can supply, the penthouse compressor automatically cuts in. At times when there is no need for the 90-pound service, the basement unit may be shut down and the penthouse unit made to carry the load—as permitted by the by-pass. This is frequently done in order to equalize the operating period of and consequently the wear on the two units.

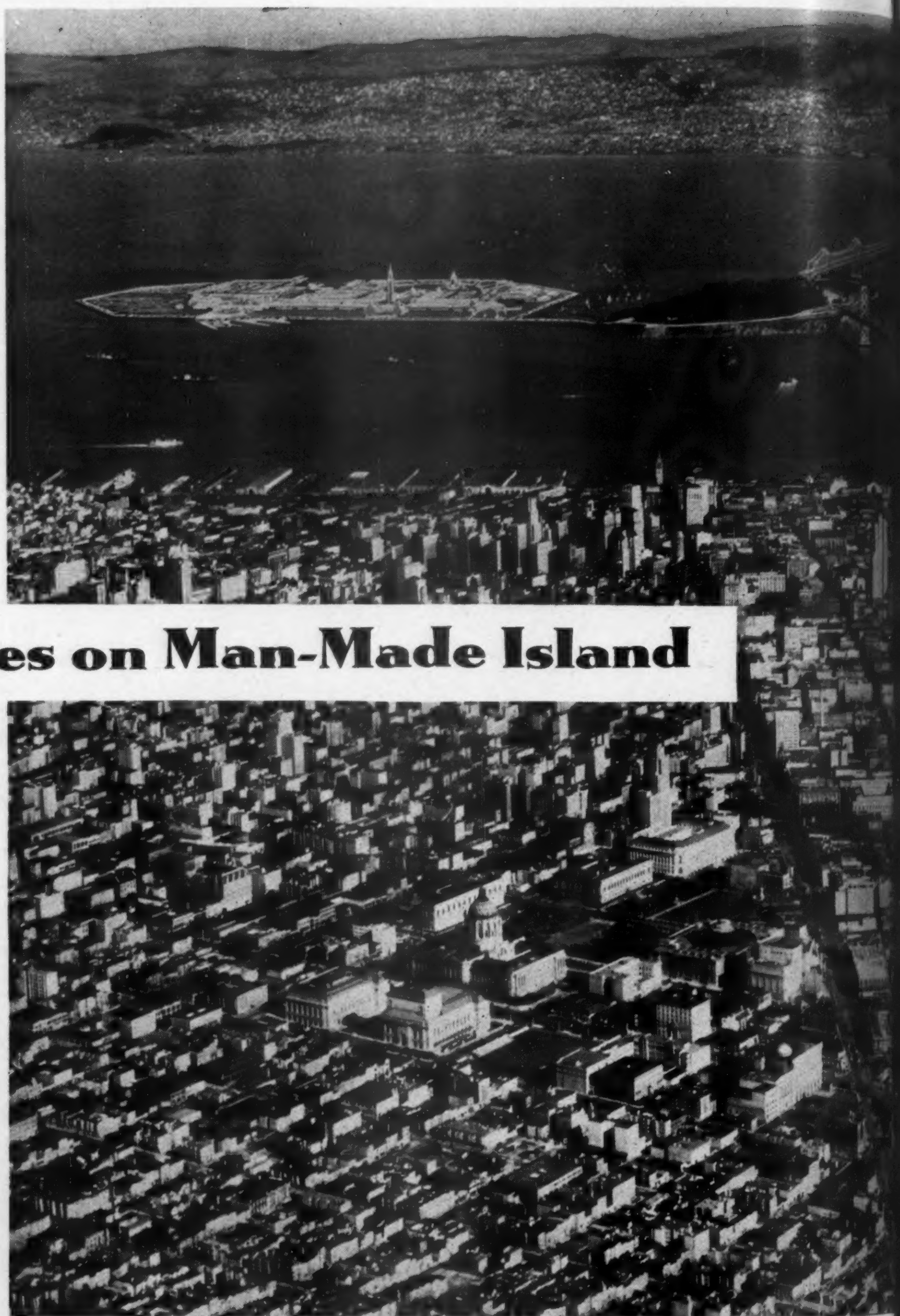
According to the building management, this is one of the first medical structures to provide compressed air to the tenants at any time day or night. In dental work, particularly, one or more of the tenants may wish to make evening appointments to suit the convenience of patients, or to do some work in the laboratory. While the compressed-air service is ordinarily cut off at a certain hour in the evening and on Sundays and holidays, it is immediately turned on at the request of even one tenant as he enters the building. He simply speaks to the elevator operator on duty or to the watchman, who starts the basement compressor without delay merely by pressing a push button.

Utilization of air by the building itself is for the ordinary purposes. The high-pressure line from the basement passes up an elevator shaft and is tapped at each floor. This 90-pound air is used for blowing out dust accumulations in elevator shafts and cages; for cleaning and blowing out motors and other mechanical equipment; for freeing some water lines and gas lines of the sediment that collects in them; and for operating paint spray guns. A number of pneumatic-tired wheelbarrows and trucks are employed in the building, being preferred because of their noiseless movement. The tires are inflated to 45 pounds pressure; and it is more convenient to do this in the building than to take them out to a service station.

As to the air applications by the tenants, some of them are described in connection with the illustrations. These and others are included in the following summary: Dentists—atomizers, driers, warm-air syringes, saliva suction instruments, blowpipes, blowing out hypodermic needles so that rust will not clog the holes; physicians—atomizers for spraying the nose and throat, suction equipment for sinus treatment, nebulizers, cooling sunlight lamps, not to mention aerating the water in their tropical-fish bowls; laboratories—blowpipes for mechanical dental work, providing pressure for gas burners, cooling X-ray tubes (lately being displaced by oil cooling); surgery—ether vaporizers, sprays, and, possibly, other appliances.

FAIR SITE FROM THE AIR

On this photograph, taken from above San Francisco, an artist has sketched Treasure Island as it will appear when the buildings for the 1939 Golden Gate Exposition have been erected. In the distance are Oakland, Berkeley, and Contra Costa. The new San Francisco-Oakland Bay Bridge is in plain view, and the artist has shown the highway that will link the fair grounds with it via Yerba Buena Island. The widest street extending vertically in the lower half of the picture is Market Street. At its shoreward end is the tower of the historic Ferry Building from which lines of ferries will run to the fair site.



William L. Wright

World Fair Rises on Man-Made Island

ON THE normal construction job, it is the duty of compressed air to excavate the foundations—but in the case of the 1939 Golden Gate International Exposition in San Francisco Bay the foundation problem was one of building up instead of digging down. And compressed air had a part in that work, too.

This World Fair will be held upon a 400-acre island, reclaimed for the purpose in the center of the harbor. Upon its completion this summer, it will be the largest island yet built by man. A fleet of eleven dredges pumped for eighteen months to draw from the bay bottom the 20,000,000 cubic yards of black sand confined within a rock sea wall.

Uses of compressed air on a diesel or even an electric dredge are many and vital. One instance in point is the shore-powered electric dredge *Marshall C. Harris*, which established a record in straightaway operation by pumping for 196 hours with no "time out" and, again, for 262 hours with only fifteen minutes lost in changing pontoons.

The *Harris*, largest shore-powered dredge on the Pacific Coast, requires compressed air to operate its ladder and to swing and to spud drums from a central control station in the pilot house. Quick-release valves, that permit the air from brake cylinders to be exhausted from the cylinders direct, make for the necessary fast action; and the use of compressed air extends even to its signal horn.

Like the *Harris*, which has been termed a "floating industrial machinery plant," the ten other dredges that did their share in building up the World's Fair island also used air. The result of their united efforts is a flat expanse of sand more than a mile long, 3,400 feet wide, and standing 13 feet above mean low water in a former shoal area just north of Yerba Buena Island.

U. S. Army Engineers, with a WPA appropriation of $3,803,000, carried out the project. Sand was pumped from borrow pits at several points on the harbor floor and collected by a combination of pipe-line and sea-going hopper dredges. Encircling the 400-acre fill is the sea wall, which is more than 17,000 feet long and contains 287,000 tons of quarried rock in slabs weighing up to 3 tons.

Reclamation began in February, 1936. At one time nine dredges were operating simultaneously, and during the peak period the fill was brought in at the rate of 3,000,000 cubic yards a month. Also included in the program was the dredging, to a depth of 50 feet, of a yacht and seaplane mooring basin between the new island and Yerba Buena Island, which are linked by a causeway 900 feet long that forms one protective arm of the "harbor within a harbor." The basin is large enough to accommodate deep-draft naval and commercial vessels.

This new "Treasure Island" was built up from the bay floor with a dual purpose in mind. First it will serve as a site for the fair that will celebrate the completion of the two greatest bridges in the world—the San Francisco-Oakland Bay Bridge and the Golden Gate span across the harbor entrance—as well as the "bridging" of the Pacific by the Clipper Ships which now make scheduled flights. The buildings for this fair are already rising. At the close of the exposition, Treasure Island will be stripped of the greater part of these and will become an airport that is to be operated by the City of San Francisco for the benefit of the 2,000,000 people in the sur-

rounding cities. Directly connected by causeway and highway with the Bay Bridge, it can be reached in ten minutes from the downtown districts of San Francisco and Oakland.

On this unique foundation, dredged up instead of dug down, permanent airport structures and timber exposition palaces are taking shape under a $16,000,000 building program in which compressed air plays an essential part. The former are concentrated at the corner of the fill nearest the causeway, with its means of rapid transit, and are of massive construction.

Two steel-and-concrete hangars, each covering an area of 287x335 square feet and 76 feet high, will be completed by autumn and serve throughout the duration of the World's Fair as exhibition places. These structures are the first of their kind to be built on the cantilever-wall principle, their concrete walls being suspended from three-hinged arches, not including the lower hinge pins. This method makes it possible to effect considerable savings in steel by reducing the weight of the roof load, as well as in foundations by reason of the virtual elimination of arch thrusts. Each hangar will cost approximately $400,000.

Door openings, 200 feet wide by 40 feet high, will be closed by a temporary construction of plaster conforming to the exposition architecture. At the termination of the fair these will be replaced by sliding steel doors. Furthermore, provision has been made for heightening the openings to 65 feet in the center to accommodate airplanes with lofty tail assemblies.

Third and last of the permanent structures is the reinforced-concrete Air Terminal Building, which will be used as administrative headquarters during the exposition. Semicircular in shape, this 3-story edifice will measure 410 feet across the front elevation and 630 feet around the periphery of the rear wall. It will contain 11,600 cubic yards of concrete. When completed and ready to function in connection with the airport, this $800,000 structure will house postal, express, and customs facilities; a passenger concourse with complete office set-up; hotel and restaurant services; a meteorological station; public observation galleries—in fact, everything required for the operation of a modern municipal airport.

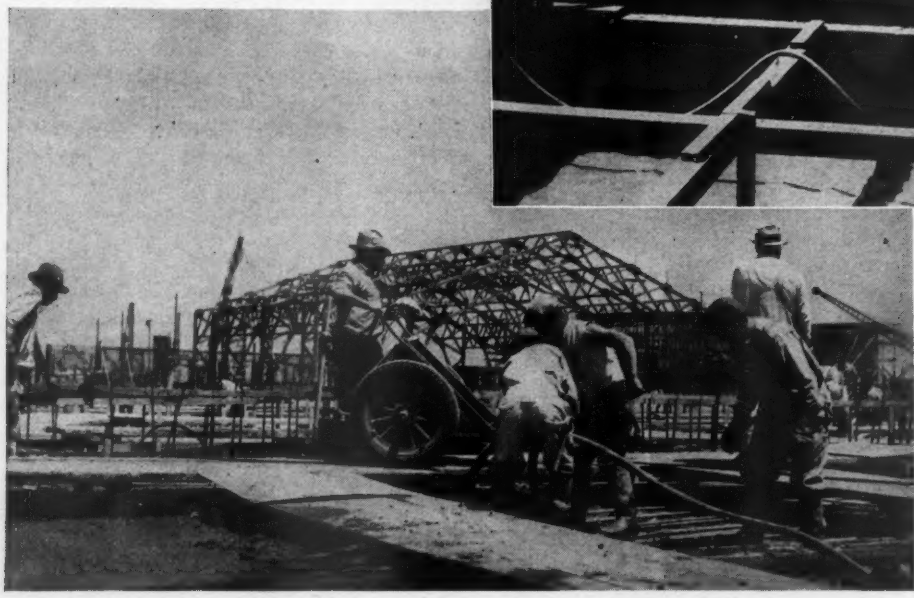
In the construction of the chain of exhibition palaces a method is being followed that differs entirely from the usual procedure. These buildings will be arranged in six great units, approximately 200 feet wide by 400 to 900 feet long, radiating from a central court and 400-foot tower that will dominate the World's Fair city. They will involve the use of 10,000,000 board feet of lumber, and also will be framed upon 3-hinged arches and be bolted together to facilitate dismantling in clearing the run-

NOW AND AS IT WILL BE

Above is the fair site from the air, with the first of the exposition buildings under construction at the left. This is the largest artificial island ever built, 20,000,000 cubic yards of sand having been dredged from the bay bottom and confined within a sea wall containing 287,000 tons of rock. Following the close of the fair, the island will become an airport to serve the Bay District. With that in mind, some of the buildings will be of permanent contruction, the two pictured here being of such form and dimensions that they can be used later as hangars. At the left is an artist's sketch, showing the island as it will appear during the exposition. In the left foreground is the 110-foot-wide causeway that will connect it with Yerba Buena Island and the Bay Bridge.

CONSTRUCTION SCENES

Compressed air is contributing in numerous ways to the building program. The picture below shows air-powered concrete vibrators being used as the foundations are poured for the $800,000 administration building which will later serve as the terminal building for the airport. At the right, air hammers are driving wood piling, forming sheathing within which to excavate foundations.



ways for the future airport. In carrying out this part of the project, compressed air is helpful in drilling bolt holes in timber arch members, in vibrating concrete, blowing out forms, and in doing the miscellaneous tasks now generally standard practice in the construction field everywhere.

More than 25 per cent of the Exposition's $16,000,000 construction program has been completed, and another 25 per cent, calling for an expenditure of $4,000,000, is progressing under a dozen separate contracts under the direction of W. P. Day, vice president and director of works for the exposition company. Roadbuilding is moving forward along two fronts: six lanes of highway across the causeway to Yerba Buena Island and then to the Bay Bridge, and four ferry slips that will raise the capacity of Treasure Island's transit system to 50,000 vehicles hourly at peak periods.

On each of these fronts compressed air has work to do, such as drilling holes in timbers and piles for bolts or in rock for blasting. The roads have been planned with the dual function of the island in mind. Only three of the six will be of permanent construction: the other three, for heavy exposition traffic, will be carried where necessary upon timber trestles so as to reduce to a minimum the work of excavating along the steep slopes of Yerba Buena Island. They will be removed after the exposition is ended.

Highway connections with the Bay Bridge will involve no left turns across traffic—an intricate grade separation, with ramps, bridges, and roads on both sides of the tunnel that constitutes the central point in the Bay Bridge, will handle all traffic streams without interference. The cost of the highway system is estimated at $600,000. Construction is underway, and is also being supervised by U. S. Army Engineers.

A similar sum is entailed in the case of the ferry slips and the terminal building that will surmount three landings on the western, or San Francisco, side of the island. The fourth slip, on the Oakland side, will be temporarily equipped as a railway apron to handle carloads of construction materials and exhibits until the opening of the fair calls for its conversion to passenger use.

Also advancing is the water system that will supply the 20,000,000 people that are expected to visit the exposition city in 1939 and, thereafter, the airport. San Francisco water will be brought across the Bay Bridge through a pipe line having spherical and sliding joints that will enable it to flex with the bridge structure. The water will be stored in a 3,000,000-gallon reservoir near the crest line of Yerba Buena Island, and from there will be distributed for general use and for fire protection through piping more than 16 miles long to every corner of Treasure Island.

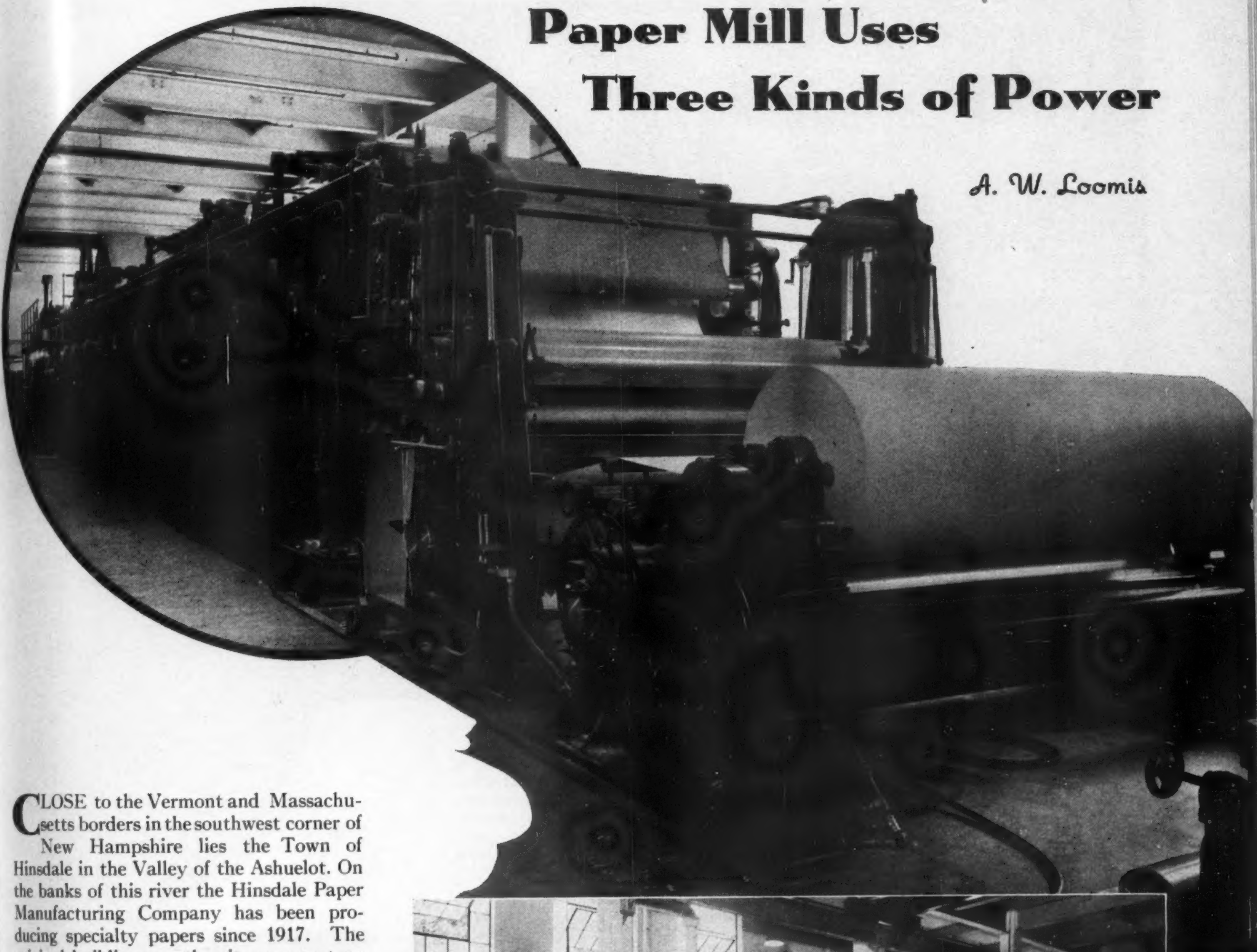
Meanwhile, other aspects of the 1939 "Pageant of the Pacific" are progressing with the construction program. Spurred on by a $5,000,000 appropriation from California, nearly half the states in the Union have taken legislative action looking towards participation; and foreign nations are negotiating—several, including Japan and all the Central American countries, having made formal engagements. Already, nationally ranking firms are listed among the industrial exhibitors, and more than 1,500 applications for concessions are on file.

The exhibition palaces will be windowless, air conditioned, and artificially lighted by day and night so as to assure uniformity in the matter of display. Contractors' equipment will be placed in the Hall of Mineral Industry, while the Palace of Business Progress will be given over to the latest furnishings and supplies for office use. Other buildings will be devoted to homes and gardens; electricity and communication; foods, beverages, and agriculture; health, science, and education; the fine and liberal arts; international exhibits; and to every other field of progress.

The keynote of the $50,000,000 fair, educationally, will be human achievement in transportation and communication as evidenced by the two great San Francisco bridges, the air conquest of the Pacific, the vast western hydro-electric projects, radio, television, and kindred developments. Popularly, the fair will stress the added leisure that has been bestowed upon mankind by these advances, as well as the recreational wonderland that the eleven western states have to offer. The scenic features of this region and its agricultural-industrial resources are strikingly displayed in the Vacationland Palace and the Hall of Western States; and a 40-acre Midway, combined with land and water sports, will provide amusements sufficiently diversified to satisfy everybody.

Paper Mill Uses Three Kinds of Power

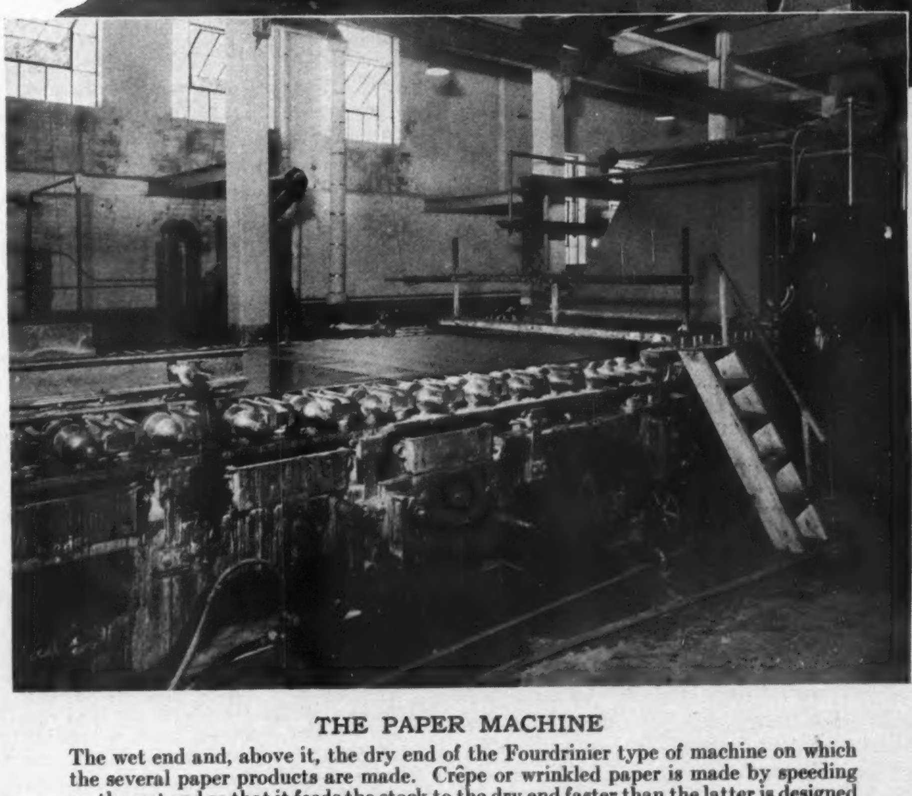
A. W. Loomis



CLOSE to the Vermont and Massachusetts borders in the southwest corner of New Hampshire lies the Town of Hinsdale in the Valley of the Ashuelot. On the banks of this river the Hinsdale Paper Manufacturing Company has been producing specialty papers since 1917. The original buildings on the site were put up as early as 1877, this date, in large brass letters, having been proudly fastened to the chimney of the power house erected by the company. Previous to their use for paper making they had for many years served as a woolen mill.

In November, 1935, a disastrous fire destroyed the mill with the exception of the steam power plant, with its dated chimney, and a water-wheel drive. The management immediately made plans to rebuild it and to continue operations on the same site. Seldom has such a manufacturing concern the opportunity entirely to reconstruct its plant from the power-supply on through to the paper-handling equipment. As was to be expected, the company made the most of this unique situation from the standpoint of its special-paper production problem, its location, and the modern machinery available for its purpose.

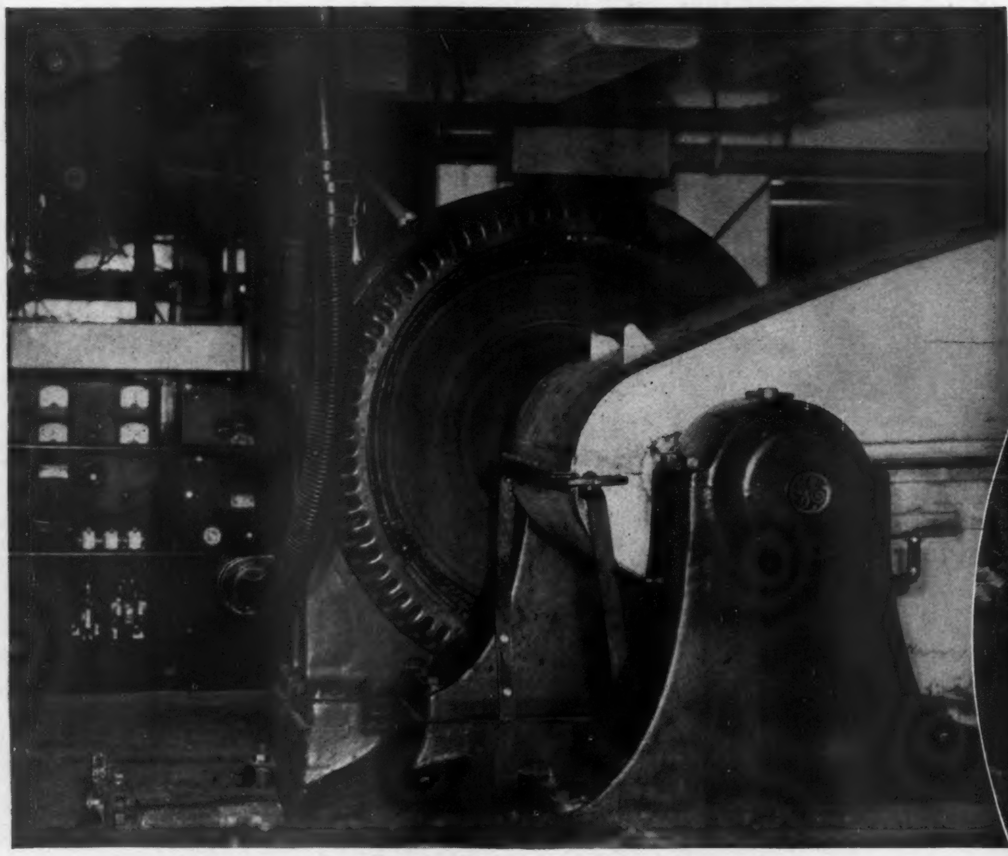
The old mill contained two paper machines. The new mill has only one; but it turns out more paper with about half the amount of coal that was formerly consumed. Much of this increased efficiency is attributable to the new paper machine and to an unusual water, steam, and diesel-engine power-generating system.



THE PAPER MACHINE

The wet end and, above it, the dry end of the Fourdrinier type of machine on which the several paper products are made. Crêpe or wrinkled paper is made by speeding up the wet end so that it feeds the stock to the dry end faster than the latter is designed to take it. This machine replaces two that were destroyed by fire, and is more productive with one-half the consumption of coal for power than were the two old ones combined.

POWER DAM ON UELOT R



A DUAL-SERVICE MOTOR

This 350-hp. synchronous motor is connected by chain drive to a line shaft that is normally operated by a water turbine. When water power is abundant, this motor acts as a generator and develops 440-volt alternating current that is carried to a switchboard in the power house for use in other parts of the plant. But when there is not enough water power available for the operation of the line shaft, then the unit serves as a motor and makes up the deficiency. The changeover from generator to motor is effected automatically.

A few hundred feet above the mill on the Ashuelot River is a dam which provides an 18-foot head of water. This is utilized to operate a 625-hp. S. Morgan Smith water turbine which makes 138 rpm. and is connected to a line shaft by means of the rope drive that survived the fire.

Pulp is brought into the mill completely processed and ready for making into paper. It is first put into beaters for a length of time varying from two to four hours, depending upon the type of paper being manufactured. There are two such units in service for separating and conditioning the pulp fibers.

From the beaters the stock flows by gravity to cylindrical, wooden stock chests that are directly beneath them. Thence it is pumped to either one of two Jordans, cone-shaped machines for crushing the wet pulp and further separating and softening the fibers. From the Jordans the stock is discharged right into the mixing chamber at the wet end of the paper machine.

The two beaters, the two Jordans, and the stock pumps are belt driven from the line shaft connected to the water turbine. The amount of power that this turbine will develop depends upon the volume of water in the river, and this varies considerably at different times of the year. When the river is high, more power is generated than is required by the beaters and pumps; but in the late summer, when the water obtainable from this source is limited, then additional power is needed.

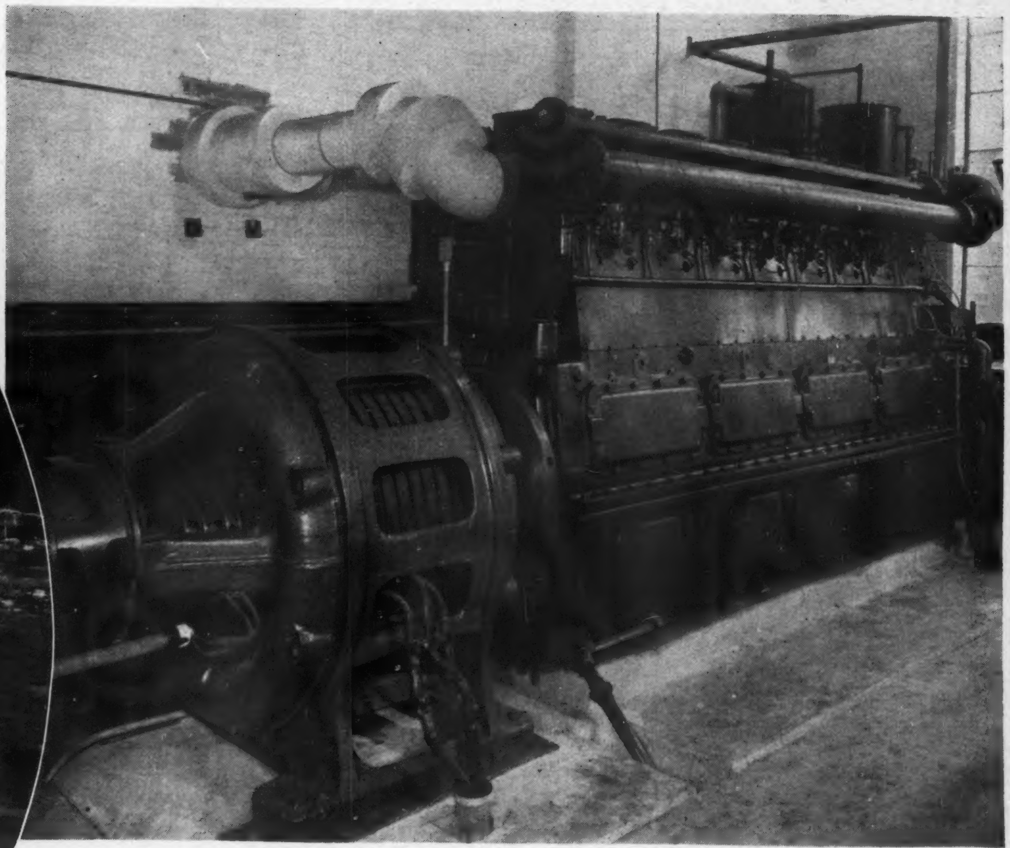
In order to make use of all the available power and to supply additional power when necessary, a 350-hp. synchronous motor has been connected to the line shaft by means of chain drive. This motor acts as a generator when the water turbine provides excess power. Alternating current is developed at 440 volts, 60 cycles, and is carried to a central switchboard in the power house for use in other parts of the plant. The changeover from generator to motor is entirely automatic, and current is taken from the switchboard at times when the unit acts as a motor.

The paper machine is a standard Fourdrinier made by Rice, Barton & Fales, Inc.

A BEATER

This is one of two similar machines in which wood pulp is treated for from two to four hours, depending upon the paper to be made, to separate and to condition the fibers. Before delivery to the mixing chamber at the wet end of the paper machine, the stock undergoes further crushing and softening in two cone-shaped machines or Jordans.

M ON UELOT RIVER



THE DIESEL ENGINE

The Hinsdale plant is unique in that it combines water, steam, and diesel power. Water power drives the pulp-processing machinery, and during periods of ample stream flow the surplus is used to operate a 440-volt generator. Steam is required for driving the paper-making machine and for heating the drying cylinders, the excess also serving to develop 440-volt current. During the summer months, when the water is low, any deficiency in power for general plant purposes is made up by a generator driven by an Ingersoll-Rand Type S, 8-cylinder diesel engine rated at 460 bhp.

The paper stock from the Jordans is diluted with water in the mixing chamber at the head of the machine. It then flows out on to the Fourdrinier wire, which keeps moving away from the mixing chamber. As it travels, the wire is given a sidewise shaking motion, and this serves to compact the pulp fibers and to settle them into a firm interlocking mass.

Much of the water in the pulp drains out during this shaking process. More is taken out as the wire passes over a series of suction boxes and a suction press roll, which is a perforated cylindrical roller within which a vacuum is maintained, and still more is squeezed out between a pair of rollers following the suction press roll. All the liquid removed in this way is returned either to the mixing chamber or to a screening machine, known as a "save-all," and re-used in the beaters.

The wet paper mat thus formed on the Fourdrinier wire is transferred to a traveling felt cloth immediately after its passage over the suction boxes. This carries it through the presses where it is transferred to another felt and then passed over a series of 22 steam-heated drying cylinders. Each of these cylinders is 102 inches long and 60 inches in diameter, and rotates on ball-bearing supports mounted on the frame of the machine. During the entire time the paper travels over these cylinders it is supported by "felts."

From the last drying cylinder the product is carried, unsupported, to the calenders. These are weighted cylindrical rolls through which the paper passes to give it a smooth finish—the number, weight, and composition of these rolls varying with different kinds of paper. This completes the manufacturing process. When it leaves the calenders, the paper is fed to a rolling device at the end of the Fourdrinier and is made up into large rolls which are wrapped ready to send to a finishing mill.

The power plant for operating the paper machine is interesting and unique in its arrangement. In addition to the water turbine which drives the beaters and pumps there is a steam plant and a diesel engine. The boiler plant, which came through the fire unscathed, has been modernized by the installation of a new boiler, superheater, and coal-pulverizing equipment. The boiler can deliver approximately 21,000 pounds of steam per hour at a pressure of 225 pounds per square inch with 125°F. superheat. A steam line runs from the boiler to a 300-hp., variable speed turbine located on the basement floor beneath the dry end of the paper machine. This

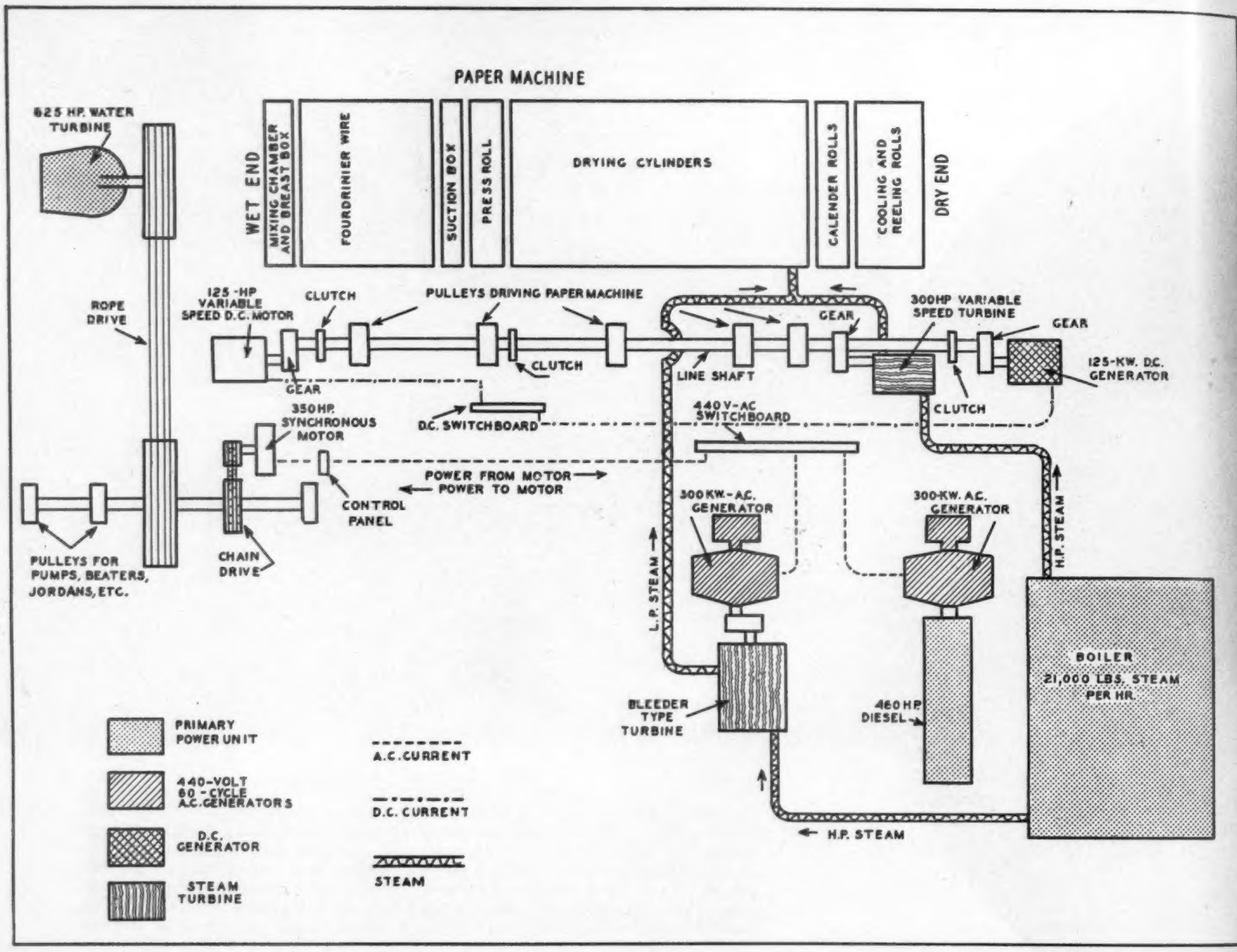


DIAGRAM OF POWER ARRANGEMENT OF THE PLANT

turbine is connected through reduction gears to line shafting which extends the entire length of the Fourdrinier and to which the various parts of the latter machine are, in turn, connected by belts and Hypoid gears.

Most of the paper produced at the plant is used for making paper towels, paper napkins, and toilet and other kinds of tissue. Many of these require a paper of the crêpe or wrinkled type. This effect is obtained by operating the wet end of the paper machine faster than the dry end—in other words, by delivering the wet paper to the drying rolls at a faster rate than they can take it. The degree of wrinkling is governed, of course, by the difference in speed between the respective ends of the machine.

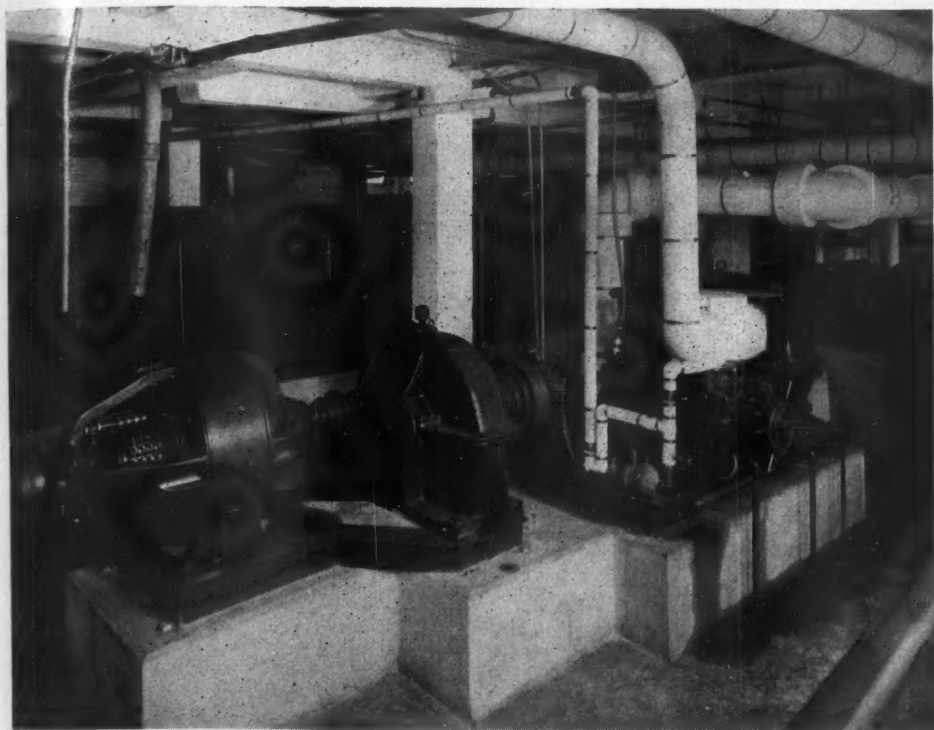
To secure this speed differential, a 125-kw., direct-current generator is connected through a clutch and gears to the variable-speed turbine which drives the line shaft. The current thus developed is carried to a switchboard located on the main floor near the Fourdrinier. From there it is transmitted to a 125-hp., variable-speed, direct-current motor on the same line shaft but under the wet end of the paper machine. By means of another clutch, the line shaft can be separated, thus permitting the two sections to be operated at different speeds. These shaft speeds are easily controlled from the switchboard on the paper-machine floor level. By this arrangement it is possible to drive the entire Fourdrinier at one speed by the steam turbine for the production of flat paper, and to separate the line shaft and to run that section of it which serves the wet end of the machine by the direct-current motor when crêpe paper is to be manufactured.

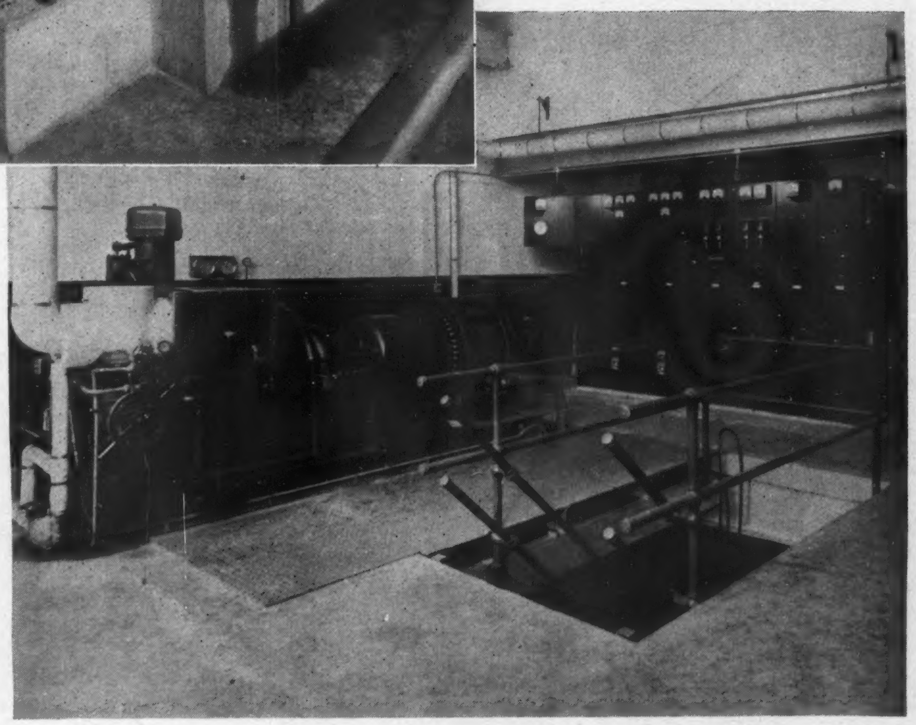
The exhaust from the steam turbine is fed to the drying cylinders and provides most of the heat required for that purpose. Condensate from the cylinders is returned to the boiler by means of a condensate pump installed on the basement-floor level beneath the paper machine.

Next to the boiler room on the main floor is a room containing a turbine generator set, a diesel generator set, and an alternating-current switchboard. The turbine generator set is of the mixed-pressure, bleeder type, and is connected to a 300-kw., 440-volt, 60-cycle alternating-current generator. Power from this source goes to the switchboard nearby for use where needed throughout the plant. The turbine has a bleeder connection at the next-to-the-last stage, and this provides steam for heating the buildings and additional heat for the drying rolls on the paper machine when that supplied by the exhaust from the paper-machine turbine is not adequate for that purpose.

The 300-kw. turbine generator set exhausts into a size 24-R-13 Ingersoll-Rand single-pass, surface condenser which is in the basement and immediately under the turbine. An Ingersoll-Rand MS-5 ejector serves to exhaust the air from this condenser, and a 1½ CRV Cameron pump returns the condensate to the boiler. A separate exhaust to atmosphere is intended for use during periods when the condenser tubes are being cleaned. No pump is required for circulating cooling water through those tubes. Instead, the more than ample 18-foot head provided by the dam for operating the water wheel is drawn upon for cooling water.

The diesel engine is an 8-cylinder, 10x12, 460-bhp. Ingersoll-Rand Type S unit. It also is connected to a 300-kw., 440-volt, 60-cycle alternating-current generator, which furnishes power for distribution from the master switchboard. Nearby is a 3-hp. baseplate-mounted Type 30 compressor which supplies 250-pound air for





TURBINE GENERATORS

Directly above is the mixed-pressure, bleeder-type turbine generator that produces 440-volt alternating current and delivers it to a switchboard for general use throughout the plant. A bleeder connection provides steam to help heat the drying cylinders of the paper machine and to heat the buildings in winter. The picture at the top shows the variable-speed turbine (right) that drives the paper machine through a line shaft, and the 125-kw. direct-current generator (left) that develops power for the variable-speed motor connected to the same shaft at the wet end of the machine so as to increase its speed when it is desired to manufacture crêpe paper.

starting the engine. A ½-hp. Cam-pump is used for fuel transfer. Cooling water for the engine is circulated by a 2RV-5 Motorpump which is located on the basement level. This unit has a capacity of 185 gpm. against a 25-foot head, and pumps the water through a heat exchanger in a closed system. Jacket-water temperature is regulated by varying the amount of waste water flowing over the heat exchanger.

The arrangement of the power plant, while seemingly complicated, is in fact very simple. Steam is required for driving the paper machine and for heating the drying rolls. Excess steam produced in order properly to operate the paper machine serves to generate 440-volt current. All possible use is made of water power in driving pulp-refining machinery, and any surplus also is utilized to generate 440-volt current. A shortage of water power, on the other hand, is made up by adding 440-volt motor power to the line shaft operating the pulp-refining equipment. When 440-volt current is needed in addition to the excess provided by the steam plant and the water turbine, the diesel engine generator set is used. During summer months, when the water supply is inadequate, the diesel engine is run much of the time. It is easily and quickly started even after long periods of idleness by simply turning a fuel valve and an air valve.

The 440-volt current serves to operate numerous small motors around the plant. Some of this equipment is required to drive circulating-water pumps, condensate pumps, and to start an air compressor, as has already been mentioned. There are also in use several motor-driven vacuum pumps connected with the paper machine, a hoist for transferring rolls of paper, and a Motor-compressor that provides air for general cleaning and maintenance work around the plant. The latter unit, in addition, supplies air to two jets underneath the paper-rolling device at the end of the Fourdrinier. A trimmer at each end of the roll cuts off a thin strip of paper so as to make the roll of uniform length, and the air jets blow this continuous strip into a pile away from the machine and out of the way of the operators. A bank of transformers located outside of the plant converts the 440-volt current to 110-volt current for use in the lighting circuits.

The bulk of the paper produced is sold to an adjoining plant where it is cut, folded, embossed, and packaged for various purposes. Both 440- and 110-volt alternating current at 60 cycles are sold to this plant for lighting and for driving small motors on cutting, folding, embossing, handling, and packaging machines.

McClintock & Craig, consulting engineers of Springfield, Mass., laid out the Hinsdale plant and designed the unique power hook-up as well as the buildings housing the equipment.

A "STEPPED" STREET IN THE PERA DISTRICT, ISTANBUL, TURKEY

Dawn Breaks in the East

Frank A. Ashby

HOW often one hears in life, "I wish I could travel." It falls to the lot of some to visit and to explore the far corners of the earth, ever to go on and on with restless energy, while others fulfill their destinies faithfully and well in office or shop, losing themselves by the fireside in some book of travel or adventure when the day's work is done.

Come with me on a trip to the East, those of you who in your hearts long for the romance and adventure of ancient places—to Turkey, that land of Sultans, of beautifully modeled mosques from the shimmering towers of which the priests still call the faithful to worship, that land of gorgeous mountain scenery, awe-inspiring and noble in its majesty, sending forth its challenge to explore and to wrest from its heights the precious metals to which feeble man aspires.

Turkey today accepts that challenge. Gone are the days of Sultans and harems, of neglected lands and poverty. Now, with a president whom the people worship, for he saved their country, the people are going forward with body, soul, and spirit toward one end—to bring Turkey to her place in the sun, back to the glories of former days.

On arrival at Istanbul from Athens, Greece, I was treated with the greatest courtesy by the customs officials and taken in a modern taxi to a hotel overlooking the fine harbor. It was all that could be desired, with a balcony on which one could sit and view ships from all corners of the earth, coming and going, each one portraying a card in the hand of fate, each one signalizing development and success, not so much in the selling of goods for money but in the international exchange of goods.

My interest lay in mines, and through the courtesy of Messrs. Adil Gabai & Coanca, representatives of the company for which I was traveling, it was arranged that I should visit those that are being developed by a department of the government known as the Mining and Research Institute, which is under the able management of B. Gencer and the famous scientist Hade Galib.

The first real sign of progress was forcibly brought to my notice when I found I could purchase for about $50 a railroad ticket good for one month and for first-class accommodations on any ordinary train anywhere in Turkey. One could stay on the train all that time, if one so desired, and it cost no more. Sleepers, etc., were extra, of course.

Mr. Gabai and I left Istanbul at seven one evening and arrived in Ankara at 9 a.m. the next day. This town is the Washington of Turkey—the seat of government. We immediately went to the offices of the aforementioned institute, and there, over several tiny cups of delicious coffee, the trip was planned. The institute kindly loaned me an interpreter, and, together with my company's Turkish service engineer, we departed for the first mine on a Sunday morning. On our way to the station I was struck by the number of storks which flew around lazily and built their nests on the housetops, unmolested. I was told that in Turkey the stork is the bird of good luck; and to have one come to rest on the roof indicates contentment for the family under it.

We reached our first stop, the Village of Keskin, in the evening. There a car awaited us and took us, after half an hour's drive, into the mountains where camp had been established and where I was introduced, with true eastern politeness, to the superintendent. After a plain but good dinner we were soon asleep in comfortable beds, for the people here rise with the sun, which means four o'clock.

The following morning we inspected the property, large deposits of molybdenum which are being developed by the institute and will then be handed over for production. For efficiency, it would be difficult to find better workings anywhere. Two oil-engine-driven portable compressors, each in its separate house, all beautifully clean and with the tools in their correct positions on the walls, supply air for the mine. Type R-39 Jackhamers are used to bring down the ore, and D6U hoists for dumping it, while water for its reduction has been made available by running a pipe line to a point in the mountains many kilometers distant. Drill steel is reconditioned by a pneumatic sharpener.

With our tour finished around 6 p.m., we returned to the superintendent's quarters and had dinner. As our train did not leave until midnight, we played Turkish poker; but as the cards were not marked like those to which I was accustomed, and as the money was somewhat strange to me, I found it difficult at first to follow the game. My friends noticed my dilemma after I had let one big "pot" go, and proceeded to help me out. After that I did not do so badly.

Once more on our way we came to the Village of Chiftahan at 10 a.m. the next day. Now we were really in wild country. Snow-capped mountains towered around us. Casually inquiring as to the location of the gold mine which we had traveled to see, was told by our interpreter, "Four hours on horseback." As horseback riding is not one of my accomplishments, I looked upon the trip with some foreboding. However, there was no turning back, and in a short time three horses were placed at our disposal. After half an hour or so I began to feel more at ease in the saddle, although the narrow trail led up and up, the rocky walls alongside sometimes rising and then dropping sheer for hundreds and thousands of feet. Passing us at intervals were trains of don-

Ewing Galloway Photo.

MODERN TURKISH ARCHITECTURE

Great strides have been taken in many directions by Turkey since it became a republic in 1923. New buildings have been erected in Ankara, the capital, to house government offices, and there has been a distinct trend towards the modern in architecture. Here is shown the Ismet Pasha Institute in Ankara.

keys carrying supplies. In our ascent we encountered Old-World villages where life has remained unchanged for centuries. Children looked at me as at some strange creature, but all were polite. I was told that the mine paymaster regularly makes this trip by himself with the entire payroll and no gun! The government has cleaned up, and done a good job. Even the huts, I noticed, were numbered.

At last we reached the camp, at least the main office. The real camp was 6,500 feet above sea level. It was cold, noticeably so in contrast with the temperature down in the village. We slept well that night, and the following morning, up with the sun, started the climb toward our objective. At this stage, I believe, some of our would-be adventurers might call it a day. At the 3,000-foot level we arrived at the first workings. Here, as at the molybdenum mine, everything was modern. A portable was operating twenty hours a day to furnish the necessary air, and Jackhamers and a sharpener were in use.

Continuing upward, we were soon in the snow belt, where extreme cold was experienced. Snow was falling heavily, making the ascent exceedingly dangerous; but on we had to go to the main camp at elevation 6,500. There the sky was clear and the view glorious. At those workings we found two oil-engine-driven portables, each properly housed and serviced and also running twenty hours a day with perfectly clean exhaust. They, together with all other heavy equipment, had to be hauled up from the railroad station in pieces and assembled on the spot. By reason of this, and the remoteness of the base of operations, compressors of the Ingersoll-Rand type had been chosen because they combine light weight with reliability. In winter when the snow in the passes is waist high the camp is isolated, making it dependent upon itself. At times like that it is essential that all machinery function without fail.

In the afternoon, with the inspection of the mine completed, we began the descent. One man, to my astonishment, sat down on the snow, propelled himself forward slowly, and in a moment was sliding down the steep slope at amazing speed. I wondered how he would ever stop, but stop he did, and just at the right place. It took us a full hour to get down to the point which he had reached in two minutes! Another surprise was in store for us when the superintendent excused himself to reënter the mine at the lower level. He ran down the mountain trail at top speed. I held my breath; but he had no difficulty in making his objective, and by the time we had gingerly climbed down, he had attended to his business and was awaiting us.

Snow had ceased falling; but about halfway down it started to rain heavily, and we were pretty well soaked when we arrived at the office. Clothes dried, and a good meal, we were soon in bed. Not a sound disturbed us, except the muttering of the service engineer who was talking French in his sleep. He knows two English words—"Shut up" —which he uses effectively. On this particular night, however, we turned the tables.

Up betimes next morning, we bade goodby to our hosts and mounted our horses for the return trip to Chiftahan. We reached the village safely after four and a half hours of riding, although the descent turned out to be even more difficult than the ascent.

Ewing Galloway Photo

A SECTION OF ISTANBUL

This city, formerly known as Constantinople and occupying the site of ancient Byzantium, is the principal one in Turkey. Much of the commerce of the country flows through it and, until the form of government was changed in 1923, it was the national capital. The modernization movement apparent throughout the land is gradually transforming the physical appearance of Istanbul, as new buildings are rising in large numbers. The customs of the people also are changing. This picture shows a section of the city, with the Galata Bridge in the foreground. The Galata District is at the left, with the Galata Tower in prominent view. In the right distance is the partly rebuilt Pera District.

Ewing Galloway Photo.

INTERIOR OF SANCTA SOPHIA MOSQUE

This is one of the world's famous buildings. It was erected by Emperor Justinian of Rome in the sixth century and served as a Christian temple until the Turkish occupation in 1453. Since that time it has been a mosque. It is generally conceded to be the finest example of Byzantine architecture in existence. When it was constructed, the exterior walls were covered with mosaics on a gold background. As these depicted Christian subjects, they were covered with stucco after the Turkish occupation. All the interior columns on the first floor are of porphyry; and marble was used abundantly as a wall facing.

When we had set out the air was crisp and cool, but at the foot of the mountain the heat was intolerable.

The last property to be visited was a large lead and zinc mine. Before our departure it was necessary for us to provide ourselves with food for the journey. We were able to purchase sardines, cheese, bread, and cucumbers, and on these we subsisted until we reached our destination. The train we caught had no sleepers, so it was the cushions for us that night.

The following evening we came to the Town of Elaziz where we remained overnight, strange eastern music lulling us to sleep. Our objective was still 50 miles away, and over roads which would make your hair stand on end. There was room for one car only—and one false move would have meant a drop of thousands of feet. But nothing untoward happened, and we came at last to the camp situated in a village called Keban. All the people there were Turkish, with the exception of a young German engineer who spoke English well. By this time it was midday, and the heat was intense. But on we had to go, as the mine lay approximately 3,000 feet higher up. We did not finish our tour that afternoon, and went back to camp where, in the solitude that reigns over the country at sunset, we heard the priest from the tower of his little mosque call the faithful to worship.

At dawn we were again on our way to the workings which, for efficiency and up-to-date equipment, were found to be equal to those already mentioned. We spent the whole day there making our inspection and talking shop. That evening we were informed by the superintendent that his wife would take dinner with us. That meant a shave and a clean-up. It was a gala event. We had not seen a lady for so long, particularly one so lovely, that we forgot all about the heat, the cold, the food—in fact, everything but her presence. They were on their honeymoon—she, out there in the wilderness, doing all her husband's cooking over a primus stove and doing a wonderful job, so he proudly told us. Added to that accomplishment, she was a crack shot. She carried a small gun and could swing around and hit a 2-inch target behind her in one second.

In order to catch our train for the return trip to Istanbul, we had to get up at three o'clock the next morning. Rain had fallen during the night, and the going was dangerous. But we arrived safely and in ample time to purchase the necessary provisions. All day we ambled along, and at night slept on the cushions. Breakfast at 5 a.m. on sardines and cheese. Try it some time. Same lunch, same dinner. Nightfall and more cushions. Next day the same story until, at last, we reached our starting point, the Town of Ankara. There I left my friends with genuine regret. They had been good pals, taking the rough with the smooth, as all must do on the road.

I continued my journey to Istanbul, arriving there the following morning. With everything attended to, and all good-bys made, I steamed out of the harbor as the last rays of the setting sun silhouetted high against the sky the tall towers of the mosques, standing as they have done for generations, holding out, it seemed, a hand at parting, a token of friendship—friendship given freely to all the world, the hand of the new Turkey, possibly disproving the familiar adage, for who knows, East may meet West.

Determining Pipe-Line Depths with Air

Elton Sternett

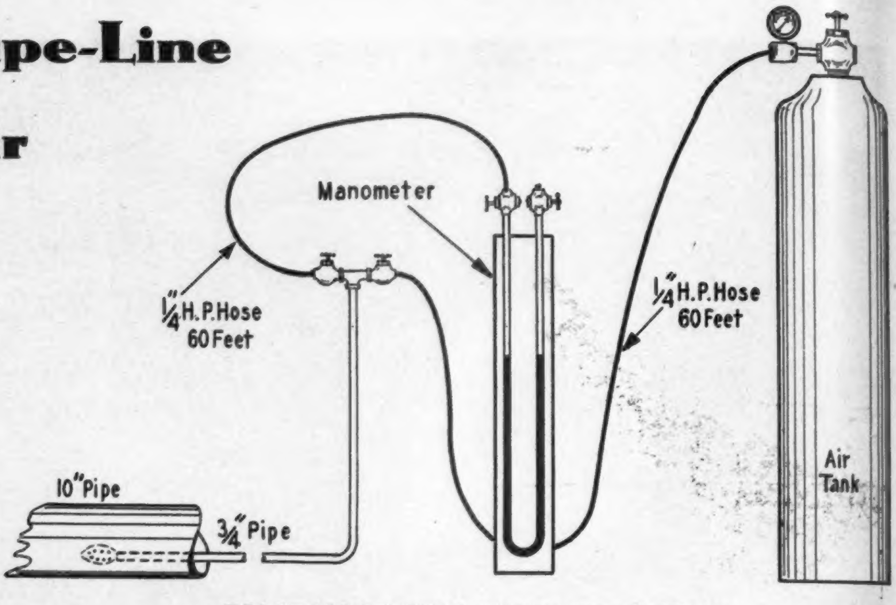


DIAGRAM OF EQUIPMENT HOOK-UP

A CENTURY ago a swampy, choked, steep-banked bayou threaded its way from near Houston, Tex., to an uncertain junction with the San Jacinto River. In its present enlarged, straightened, and deepened form, it is the Houston Ship Channel, through which an average of 500 transits a month are made by ocean-going cargo carriers, placing Houston third among the seaports of the United States.

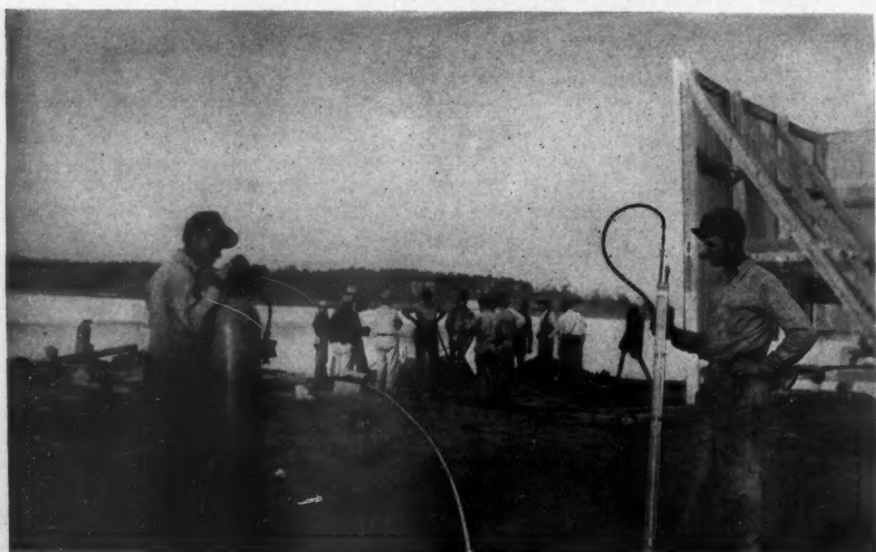
As is true of most waterways developed by the aid of man, the transition from the tenuous slough, up which flat-bottomed steamboats were oftentimes cordelled by lines thrown around the nearest cypress knees, to the well-lighted canal of today, has been gradual and accompanied by numerous delays. As Government aid could be secured and opposition stifled, the earlier elbows were straightened and cuts made across Morgan's Point and other reverse turns of the coastal watercourses until, by 1925, the canal had a 30-foot depth to the turning basin heading the ship channel, ending, as was then supposed, any further work on the project other than the normal maintenance dredging.

With the deepening to 30 feet came the phenomenal growth of the oil industry in and around Houston; and the bed of the ship channel was "tied down" by one pipeline crossing after another until, in some sections, the warning sign, "Pipe Line Crossing, Do Not Anchor!" now vies with navigation aids in number.

Laid for the most part in shallow trenches dredged through the silt and muck forming the bottom of the canal, these pipe lines were planned to provide ample depth for shipping, taking into consideration the restrictions imposed by physical characteristics of the channel, and, naturally, were buried no deeper than was deemed necessary to assure that depth.

A continually increasing volume of freight, and the need of accommodating deeper-draft ocean-going craft, pointed to the necessity of an improvement program involving both the widening and the deepening of the canal throughout its 50 miles of length from the entry in Bolivar Roads to the municipally owned turning basin within the Houston City limits. This plan brought the many oil and gas companies face to face with the problem of lowering their lines in conformity with the new contract dredging depth of 37 feet, as compared with the earlier 32-foot maximum specified to maintain the 30-foot channel.

Covered, as the pipes naturally were with several feet of compacted silt and mud, ordinary methods of ascertaining their depth below water level—which was the first concern—were immediately ruled out. Plumbing to the pipe with the aid of a diver, occasionally feasible in open water where a line traverses hard bottom, was likewise



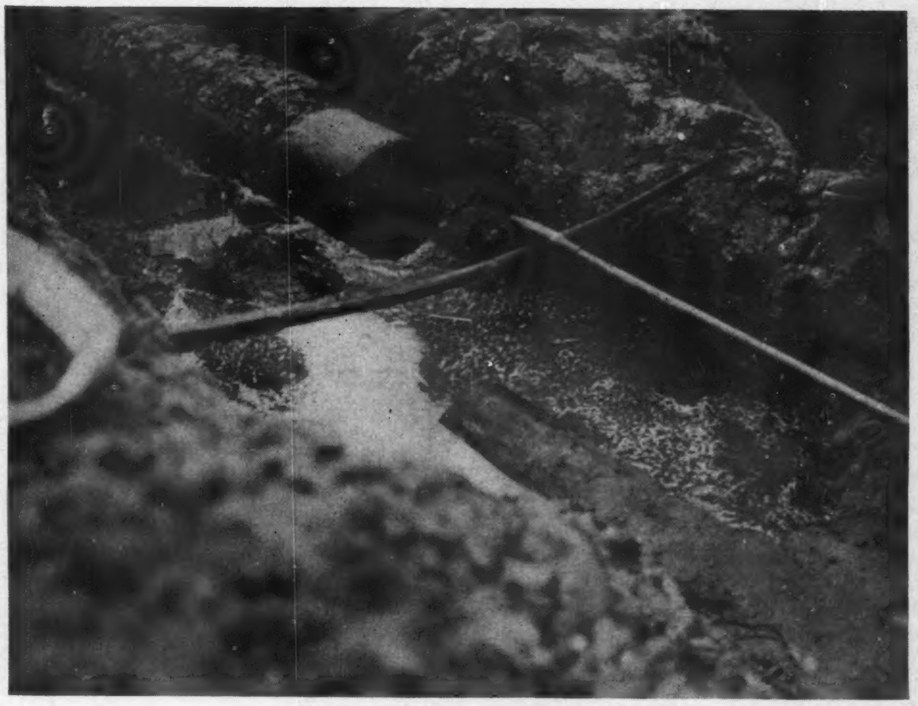
VIEWS OF OPERATIONS

At the right is seen one of the 10-inch natural-gas pipe lines raised from its trench at the bank of the canal and ready for testing. At the left of the supporting frame is the small pump that was used for filling the pipe with water. The view above shows a cylinder of compressed air and the manometer in the foreground, with surveyors and other members of the working group near the shore.

impossible, since compacted material had obscured all traces of the original ditches.

Working jointly, an oil-pipe-line company and one transporting high-pressure natural gas devised and developed an unusual method of determining the head pressure within their lines, and thus secured an accurate vertical-displacement survey of their multiple crossing. This consists of six 10-inch mains yoked together. The lines cross the waterway at Alexander's Island; and the survey was carried through without affecting traffic or, in fact, without utilizing or trespassing upon the channel in any way.

Since the six lines were yoked together, it was considered adequate to ascertain the exact locations of two pipes only, as the four others had to lie either in between them or closely adjoining. As a preliminary to actual depth determination, two base lines were laid down on opposite banks of the canal and chained with precision to avoid any possibility of error at this stage of the proceedings. Working to these, all angles between stations were turned five times for accuracy in locating by triangulation the exact points at which the pipe lines emerged from the channel in relation to the U. S. Corps of Engineers' reference stations, to which all channel deepening measurements were to be referred.

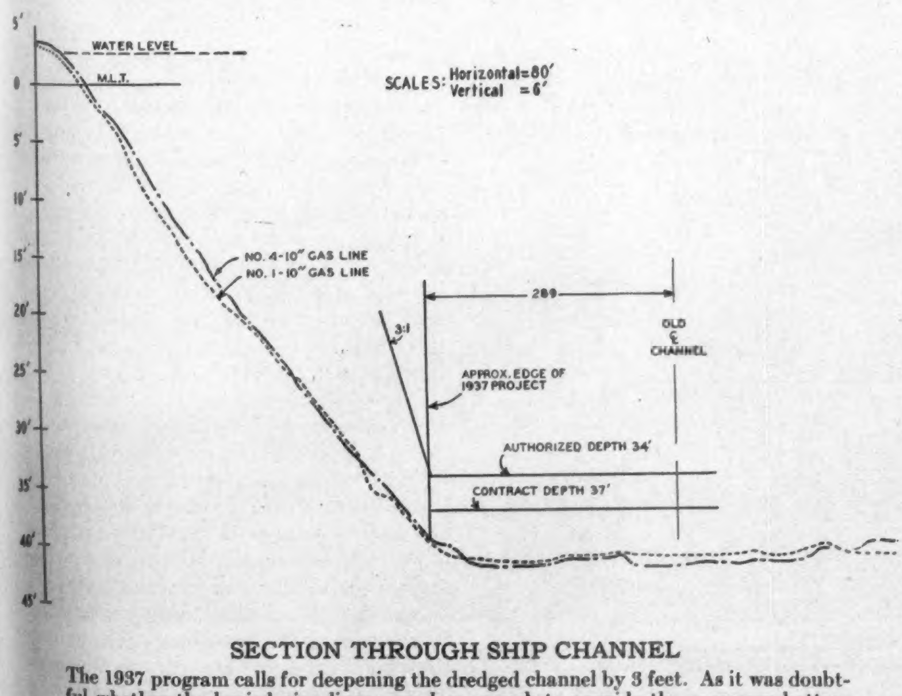


END OF CUT PIPE

The steel dam is shown welded in place across the lower part of the opening to confine the water introduced into the line and to keep it at a constant level. At the right is the special streamlined bull plug affixed to the end of the ¾-inch air pipe and ready for insertion into the larger pipe.

With the surveys completed, the actual testing equipment was assembled and transported to the shore of Alexander's Island, where the work of measurement was to be carried on. The outfit included 1,500 feet of ¾-inch galvanized pipe and collars, together with a specially streamlined "bull-plug" end piece formed so as to ride over any welding "icicles" which it might encounter within the 10-inch line to be tested and having longitudinal slits cut in it to permit water to enter while serving at the same time as a barrier to sediment or other foreign matter that might be in the line.

At the shore end of the ¾-inch pipe there were the fittings necessary to connect it with a 50-inch manometer, two lengths of high-pressure welding hose, and two large cylinders of compressed air. The latter were chosen instead of a compressor because of their greater portability and because it was possible, by the valve on each, exactly to regulate the flow of air through the ¾-inch pipe.



SECTION THROUGH SHIP CHANNEL

The 1937 program calls for deepening the dredged channel by 3 feet. As it was doubtful whether the buried pipe lines were low enough to provide the necessary bottom clearance, the locations of some of them were determined by tests. The broken lines indicate the actual positions of the pipes as ascertained by the method described.

After the base lines had been determined and the apparatus assembled, one of the outermost 10-inch gas mains of the group of six was cut, lifted clear of its bed at the water's edge, and the lower third of the open end closed with a steel dam welded in place. In this way was provided a uniform and easily determined end point in the line that also aided in the control of the water with which it was filled. Later, Line No. 4 was cut and treated in the same manner.

For the actual work of testing—for establishing the vertical distance between the water surface and the bottom of the pipe lines—each of the cut 10-inch mains was filled to the top of the welded-in dam with water from the ship channel, a portable centrifugal pump being employed for this purpose. Then, after 1,000 feet of the ¾-inch pipe had been run inside the main, readings were started and were thereafter taken at 20-foot intervals.

To obtain the actual hydrostatic head at the point where the streamlined bull plug lay within the 10-inch line, compressed air from the flasks was used to blow the ¾-inch pipe clear of water, after which operation the air supply was cut off and the line to the manometer opened. As the residual air pressure within the ¾-inch pipe was just sufficient at that stage to balance the pressure of the water attempting to enter the slits in the bull plug, the reading on the U-tube indicated in inches of mercury the exact hydrostatic head. By applying the correct conversion factor, this

gave the difference in elevation between the position of the bull plug and the base point.

Several minor difficulties had to be overcome before it was possible to clear the ¾-inch pipe of water quickly and efficiently. As the trapped water was forced through the slits the pressure of the air changed, becoming stationary when the pipe was cleared and thus indicating when to cut off the purging flow of compressed air. If admitted too rapidly, the air escaping from the far end of the pipe set up an air-lift action within the 10-inch main, causing surges of water which frequently topped the small dam or barrier at the end of that line. This necessitated refilling it to the proper level before the manometer reading for that station could be obtained. As the work progressed, experience gained in manipulating the clearing air enabled depth determinations to be made almost as rapidly as the galvanized pipe could be withdrawn and the needful surface work completed.

After accurately ascertaining the vertical displacement of the two main lines by this method, it was found that their nearest point of approach to the established dredging contour was approximately 3 feet, thus assuring the two participating companies—the Houston Pipe Line Company and the Humble Pipe Line Company—that their four high-pressure-gas and two oil and gasoline carriers were sufficiently deep to come within the limits set by the U. S. Engineers and that no expensive program of lowering was required.

As the water used for filling the two mains was drawn from the Houston Ship Channel, which is subject to the ebb and flow of the tides and carries the fresh-water run-off from Buffalo Bayou and the San Jacinto River, tests were made to determine the stratification, if any, of the water. Because of the tidal action and the frequent agitation of the water by the propellers of steamers plying the canal, it was found that a water sample drawn from any given level corresponded closely with the liquid lying both above it and below it.

BLOWING OUT WATER

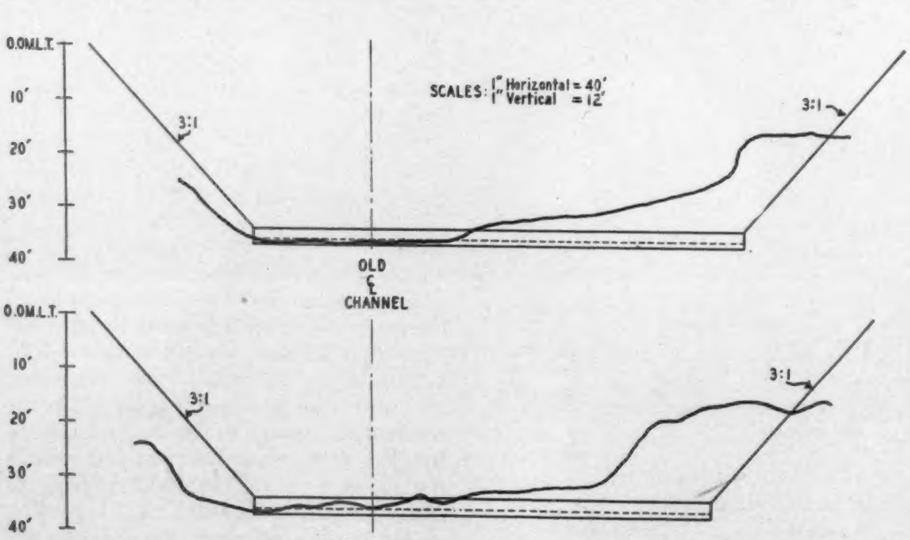
After the tests were completed, the water was blown out of the respective pipe lines by the pressure of the natural gas normally carried. They were then put back in service by welding them at the points where they had been cut.

For correlating the readings obtained, a series of check depth determinations were made with the apparatus working over the perpendicular side of the Humble Company's loading dock, where a vertical distance of 35 feet was available and where the manometer indications could be verified with a direct gauge. Use of the dock for this purpose was decided upon after attempts to tow the end of the ¾-inch line into the channel and to get direct readings from a boat had proved to be impracticable owing to the motion of the boat.

Measured Depth Feet	Total Height Mercury Inches	Conversion Factor	Reciprocal
20	17.95	0.8975	1.114
25	22.4	0.8960	1.116
30	26.9	0.8967	1.115
Average Reciprocal	1.115		

The conversion factor from pure water to mercury, as taken from a handbook on physics and chemistry, was corrected to correspond with the observed gravity (1.017) of the water used for filling the lines that were to be surveyed, giving the foregoing calibration factors.

Using these factors, the depths were calculated as plotted and, all falling within a range of 6 inches from those expected, were accepted as accurate. As a result of this unusual application of head-pressure measurement—aided by compressed air as the only practical method of clearing the ¾-inch pipe section of the manometer hook-up which served for each of the more than 100 separate determinations made—the location of the six yoked lines to within the limits just given was obtained without either disturbing or withdrawing from service the two oil and gasoline mains and two of the four handling high-pressure gas. In the case of the two chosen for the test, the water introduced in them was blown out by the gas normally carried, and they were welded tight again as soon as the measurements had been completed.



TYPICAL SECTIONS

Showing the channel as it is now and as it will be upon completion of the 1937 project.

An Effective Combination for Small Forge Shops

H. O. Tair

As a result of the prevailing demand for greater strength in mechanical construction, forgings are assuming a place of continually growing importance. Forged parts are being used in increasing numbers in all sorts of machines from typewriters to automobiles and, in fact, wherever service requirements are severe or high stresses are encountered.

In days gone, the picturesque village blacksmith pounded out forgings that sufficed for the needs of his era. The modern counterpart of the fast-vanishing smithy is the mechanical forging hammer. The larger hammers strike earthquaking blows that not even a thousand human arm muscles combined could duplicate. Moreover, they keep striking them at a pace that would soon exhaust even a superman.

Notable progress has been made in the manufacture of forging hammers in recent years. Not only has the range of sizes been extended and the number of sizes within that range increased but there also has been steady improvement in hammer efficiency owing to betterments in design and to the development of more acceptable materials through metallurgical research. Despite the fact that their service is in every sense of the word grueling, modern forging hammers stand the punishment that is their lot with truly amazing dependability. At the same time, they do more work per blow than did machines of older design.

One of the leaders in the field, the Chambersburg Engineering Company of Chambersburg, Pa., now makes standard forging hammers with falling weights ranging in size from 50 to 24,000 pounds, and will turn out larger units to order. Standard single-frame hammers are made with falling weights of from 50 to 6,000 pounds, and double-frame types from 1,000 pounds up. This concern has the distinction of having constructed the country's smallest and largest hammers, the latter being a 30-ton unit.

During the depression, Chambersburg engineers produced a series of synthetic nickel-molybdenum air-furnace iron alloys designated as Cecolloy, which has been employed with success for the cylinders of certain types of hammers. The particular virtues of Cecolloy are its strength and wear-resisting properties. It has a fine, homogeneous grain structure; its tensile strength ranges from 40,000 to 60,000 pounds per square inch; and its Brinell hardness can be controlled by heat treatment to meet the requirements of the purpose for which it is to be used.

As the result of another research investigation it has been determined that,

COMPACT FORGING-EQUIPMENT INSTALLATION

A section of the new testing laboratory of the Climax Molybdenum Company at Detroit, Mich. At the left is a Chambersburg 750-pound forging hammer, and at the extreme right the Motorcompressor that supplies it with operating power. The latter is an air-cooled, 2-stage compressor assembled with its driving motor to form one unit. Despite its small size, the machine is capable of handling the load when the hammer is working continuously at full stroke.

under average conditions, a hammer will work most efficiently and with the greatest economy if the weight of the anvil is fifteen times that of the impacting mass or ram. As a consequence, that ratio now prevails in the case of all the Chambersburg machines.

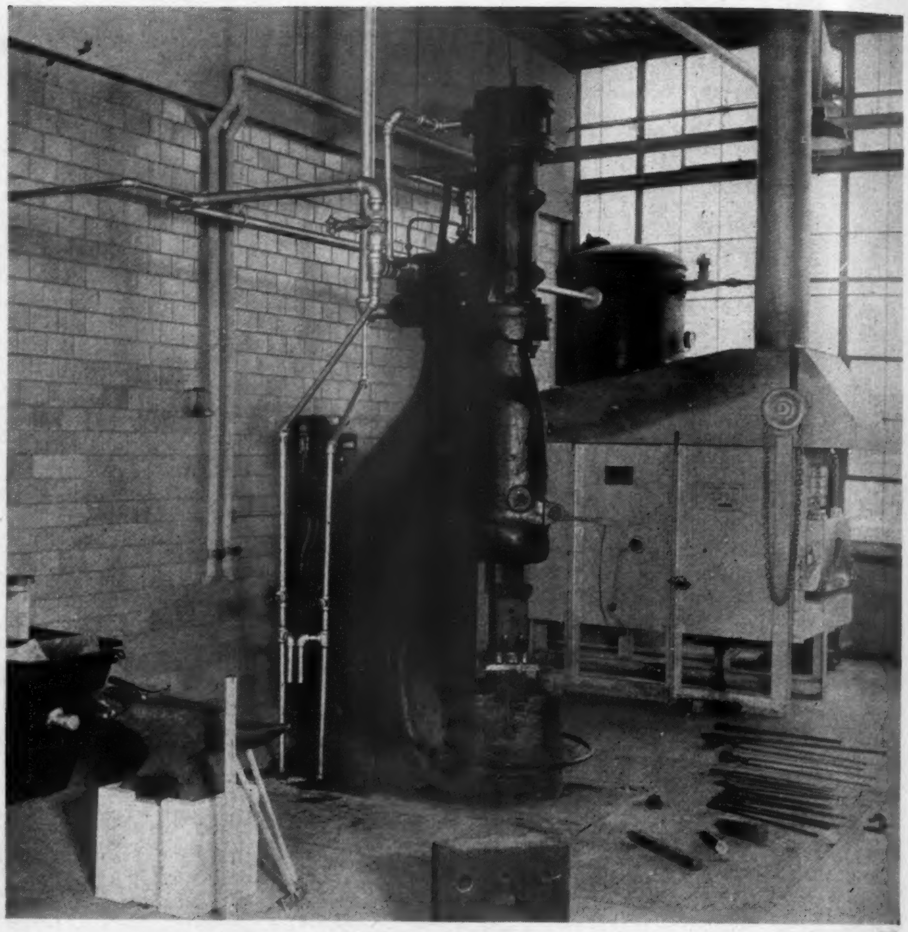
A third study has led to the designing of a new cylinder and valve which, it is claimed, effect power savings of 15 per cent and more. These developments have brought about an improvement in the impact velocity of the ram, coupled with a quick pick-up in speed. Higher mean effective pressures in the cylinder have made it possible to reduce the cylinder bore; and the new valve permits a shorter idling stroke.

Forging hammers may be operated with either steam or compressed air. Until a few years ago, steam was generally used; but now the choice depends upon the service conditions. As has been previously pointed out in these pages (March, 1936), there is a class of forge shops in which compressed air is definitely less costly than steam. In general, the higher the load factor or actual hammering time per day, the greater is the economy with steam, and the lower the load factor, the greater is the economy with air. This means that with air operation there is a gain in economy and with steam operation a loss in economy as the standby or idling time of the hammers increases. There are, of course, borderline cases where thorough study is essential in order to determine which form of power will be cheaper.

In small shops, where hammer operation is very intermittent, compressed air is manifestly the logical choice, particularly if steam is not required for purposes other than forging. Under such conditions, the savings with air are particularly pronounced because the compressor has to be operated only when hammering is actually being done; whereas if steam is employed, the boilers must be kept under full pressure at all times to make sure that power will be available when it is needed.

Aside from the consideration of economy, compressed air is usually preferable to steam because it makes for greater comfort and cleanliness. There is no hazard to workmen from hot water drips, and the smoke, dirt, and ashes from a boiler plant are absent. Hammer operators generally admit also that air imparts greater "spring" and "snap" to the hammers, and that its action is quicker than that of steam.

The development of motor-driven, air-cooled, 2-stage compressors has emphasized the advantages of air operation in small forge shops. These units are small, compact, require no foundation, and their air-cooling feature eliminates the necessity of water piping. A compressor of this type can be set up in the same room with and close to a forging hammer, resulting in what virtually constitutes a self-contained forging unit.



CLOSE VIEW OF HAMMER

Notice the general cleanliness that is made possible by using compressed air instead of steam as the medium of power for forging. As there was no use in the building for high-pressure steam, compressed air was selected on the basis of its greater economy and ready availability for service.

An installation of this kind was recently made in a new testing laboratory erected by the Climax Molybdenum Company in Detroit, Mich. This laboratory is provided with complete facilities for making chemical and metallurgical investigations of all alloys of which molybdenum forms a part. It is employed to assist in the solution of problems that arise in the field, particularly in connection with the application of molybdenum-bearing steel alloys that are widely used for high-speed tools in the Detroit industrial area. Equipment for making forgings is essential to the conduct of these researches. The building is an attractive one of modernistic design, and neatness and cleanliness are stressed. Ordinarily, forging is done only occasionally and for limited periods at a time. As there are no operations other than forging for which high-pressure steam could be used, the conditions dictated the adoption of compressed air for that service.

The forging equipment consists of a Chambersburg standard single-frame, 750-pound hammer having a cylinder of 7-inch bore and 23-inch stroke, and of an Ingersoll-Rand air-cooled Motorcompressor having a capacity of 115 cfm. at 100 pounds discharge pressure and driven by a direct-connected 25-hp. electric motor. Interposed between the compressor and hammer is an air receiver with a capacity of 96 cubic feet.

The compressor is equipped with dual control, and the change from one to the other can be made by merely throwing a switch. For intermittent operation of the hammer, or where it is desired to employ air for cleaning or for other incidental services, the opening of an air valve automatically starts the compressor. Likewise, when the use of air ceases, the machine is automatically stopped. When steady hammering has to be done, the switch can be thrown to effect the necessary constant-speed operation of the compressor.

The installation is reported to be working out very satisfactorily. Most of the forgings are small, and at times very light blows have to be delivered. This calls for sensitive response on the part of the hammer, which is readily obtained with air operation but would be difficult to secure with steam because of the condensation of moisture in the cylinder. Furthermore, the combination of Motorcompressor and air receiver assures a sufficient supply of air to operate the hammer continuously when it is striking hard blows.

THE TOLL OF ACCIDENTS

SOME almost unbelievable statistics are presented by the National Safety Council, Inc., in its 1937 edition of *Accident Facts*. For example, who would imagine that mishaps last year injured 10,730,000 persons and killed 111,000 in the United States! These staggering totals represent an injury every nine seconds and a death every five minutes. The cost, aside from sorrow and suffering, is placed at $3,700,000,000, or at the rate of $120 a second. The death rate per 100,000 of population was greater than for any year in the past thirty except one.

Accidents in homes, strangely enough, accounted for more deaths than motor vehicles, the respective totals being 38,500 and 37,800. Fatal accidents in public from causes other than motor vehicles, killed 20,000 persons, while 18,000 lost their lives in occupational accidents. The principal fatal accidents, with the percentage of deaths caused by each, were: motor vehicles, 36; falls, 25; burns, 8; drownings, 7; railroads, 5; firearms, 3; poison gases, 2; other poisons, 2; all others, 12. Among infants, burns are responsible for most of the accidental deaths. In the age group from 4 to 65 years, motor vehicles take the greatest toll. Over 65, falls are the principal cause of death.

CANADA'S MINERAL WEALTH

IN A series of articles published some months ago, we traced the development in Canadian mining during the past 30 years. In substance, that review showed that the industry, from the time of the discoveries at Cobalt, has been marked by continual expansion, a reaching out in an ever-widening circle. Great impetus has been given the movement in recent years by the increase in the price of metals and by the improvements in methods of transportation, prospecting, and treating ores.

Because Canada is a vast country of which many parts are difficult of access, and because much of her domain is covered with pre-Cambrian rocks that have been productive of many of the world's greatest mines, an extremely promising mining future was predicted for her. In the time that has passed since that forecast was made, progress towards that goal has been at a continually accelerating rate, and there is good reason to believe that the Dominion will soon lead all countries in the value of her mineral output.

Significant is the prediction made last month that dividends paid and to be paid by the Canadian mining companies in 1937 will surpass the total from South African mines. At the present rate, Canadian dividends for this year will reach $100,000,000 or more. In 1936, Rand dividends aggregated about $86,000,000. South African profits came almost entirely from gold ores, although copper is becoming increasingly important. Last year there were produced on the Rand 48,000,000 tons of gold bearing ore that averaged $8 to the ton in values. Canadian dividends, on the other hand, are derived from many metals; and for 1937 gold will provide only about 40 per cent of the total. Last year fifteen more Canadian mines started paying dividends, as against one in South Africa.

AIR-CONDITIONING INDUSTRY AS AN ECONOMIC FACTOR

AIR conditioning, to quote an authority, is being wholeheartedly accepted in America. From 1933 to the end of 1936, according to a survey just completed by the Marketing Research Division of the U. S. Department of Commerce, there has been an increase of approximately 1,400 per cent in the number of air-conditioning installations made in this country. Aside from the work and the various materials required to build and to set up these units, and the additional 263,916 hp. of motive energy needed to operate them, they involved the consumption of large volumes of water. Offhand, this may not seem to be an important factor. However, the fact of the matter is that the demand for air-conditioning equipment, if it continues to grow—and there is every reason to expect that it will—will necessitate heavy investments in waterworks equipment and sanitary works, as well as in building and other materials.

Although air conditioning, as it is understood today, is only in its infancy, it is already extensively used in the United States. Many diversified industries depend on it to provide the proper atmospheric conditions for the manufacture, processing, handling, and packaging of manifold foodstuffs and commodities, and "controlled weather" is contributing much to the comfort and well-being of workers in offices, factories, and similar establishments, and thus increasing production. Theaters and stores find that artificial cooling increases the volume of their business, especially during the summer months, while air-conditioned homes are a source of unending satisfaction to their occupants.

What proportions the industry will assume in the future is a matter of speculation; but certain it is that it will employ thousands of people and, indirectly, give work to thousands more.

SCHOOL FOR TRAFFIC ENGINEERS

VIEWED in the light of our increasing traffic problems, a recent announcement from Harvard University is good news. That institution is opening on August 16 a school for traffic engineers, with Burton W. Marsh, director of safety and traffic engineering of the American Automobile Association, as dean. It is said to be the first of its kind to be conducted under such auspices in the United States. The course will be of two weeks' duration and limited to 50. It is designed primarily for municipal, county, state, and Federal engineers. This is a step in the right direction, and probably marks the beginning of regular classes in traffic engineering in our colleges. Harvard is to be congratulated on taking the initiative.

Industrial Notes

News reports have it that an airplane has been built throughout of bakelite on the theory that that material is as strong as metal.

Substitute leather from seaweed is one of the recent achievements of the laboratory worker. The product is said to be more durable than ordinary leather and to cost less.

Experts are responsible for the statement that the world's oil-shale resources can supply enough fuel to drive all the motor vehicles that are now registered for 400 years and more. The potential production has been estimated at 300,000-000,000 barrels.

The Carboloy Company, Detroit, Mich., has announced that it is prepared to tip the spindles and anvils of micrometers with Carboloy and thus to increase their life materially. The cost for this service is $10 per instrument, including accurate adjustment.

An important advance in aviation is reported from Japan where a scientist claims to have developed a device that enables an airplane not only to ascend vertically like a helicopter or autogyro but also to increase its cruising speed by about 25 per cent. Details about it are lacking.

With the development of waterproof glues for the manufacture of plywood, the indications are that the field of application of that material will be considerably broadened. Casein glues are generally used to bind the separate layers together. The new adhesives are made of synthetic resin and acetyl-cellulose.

A new combination paint thinner and binder, known as Alasticflint Compound, is claimed to be waterproof, oilproof, and acid-resisting. It is intended for use in red-lead metal primers, aluminum paints, and enamels. Alone, it can serve as a varnish, and will not soften underwater if air-dried for 24 hours.

Something different in motor vehicles has appeared abroad. When engaged in the business of heavy trucking, for which it is primarily designed, it looks just like any other flat-deck type of truck. In an emergency, however, it can be quickly converted into a fire-fighting unit by raising a collapsible tank which has a capacity of 600 gallons. This is said to be sufficient to extinguish any ordinary fire. The deck of this unusual truck is divided transversely in the center, the two parts being hinged at their outermost ends. When these halves are in an upright position they constitute the ends of the tank, the sides, which are fastened to them, being made of canvas. The vehicle carries an adequate length of hose and a pump that can deliver 100 gpm. at a pressure of nearly 100 pounds per square inch. The container can be filled from a hydrant or convenient body of water.

Paint with chameleonlike characteristics is available for coating motors, bearings, and other equipment and parts that may become hot in service. It is said to change color as its temperature increases, and thus to give warning of overheating. Depending upon the choice of contrasting colors, red may turn to black or yellow to green, etc. In some cases the change is permanent, and in others the original color reappears after normal conditions have been restored. The latter are good for from 25 to 50 such changes before they have to be renewed, while the others will last for about one year.

Portland cement, arsenious oxide, sand, and water, in proper proportions, are the ingredients of what is said to be a satisfactory protective coating for timber piles exposed to the action of sea water. For maximum strength, a 1:3 arsenious oxide-Portland cement mixture is used; and as the former causes very rapid setting, a special gun has been devised for its application. This apparatus correctly proportions and feeds the mix. When required for harbor work, the coating on the underwater part of the piles is reinforced with wire mesh fastened with galvanized nails. Driving of the piles is permissible as soon as the mortar is thoroughly dry and does not, it is reported, harmfully affect the latter. Concrete structures similarly situated can be treated in a like manner.

To prevent surface subsidence, to permit the extraction of tons of coal now left underground, and to dispose of waste piles on the surface, an English colliery is experimenting with a system that is being used in Germany and that is said to accomplish all three of these things at the same time. As described in *The Engineer*, the waste is reduced to a fine powder by a rock crusher at the pit head, and is then forced through pipes by a combination compressed-air and suction plant to the farthermost point in the workings from which coal has been taken. The dust is applied with sufficient pressure so that it will be packed tight in the open space, where it solidifies, thus preventing the roof from falling and permitting the removal of the supporting, coal-bearing pillars.

Rubberite is the trade name of a new material for coating the inner walls of wood and steel tanks. The compound is heated in the cans in which it is supplied and, when liquid, is poured progressively over all the surfaces, or just along the seams to seal them. The resultant film, when cool, does not crack, scale, nor run, and is claimed to be resistant to most acids and caustics. About two pounds of the rubberlike material are required for each square foot of surface.

To encourage the conservation of imported fuels, Germany is said to be paying a subsidy of about $250 for every truck that is equipped to burn producer gas generated by its own plant. In this connection it is interesting to note that Great Britain also is experimenting with trucks that are designed to use producer gas, and that one of the major topics discussed at the Third International World Congress on Timber Utilization, held recently in Paris, dealt with the practicability of manufacturing gas from wood to serve instead of gasoline for the driving of automotive vehicles.

Quigley Company is offering a group of insulating refractories all of which are made from its new calcined fire clay named Insuline. The products come in different forms for special purposes and, among others, include Insulblox, Insulcrete, and Insulbrix which are capable of withstanding temperatures up to 2,200, 2,500, and 2,600°F., respectively. They are used variously for lining furnaces and in connection with ducts, flues, boiler settings, regenerator chambers, oil stills, etc., etc. For lagging, where temperatures do not exceed 2,200°F., there is Insulag. Shipped dry, it is mixed with water for application by trowel. Ground, the basic material serves as an insulating fill: sized, as an aggregate in Portland cement for the making of insulating concrete. It also comes in a form suitable for casting.

Microscopic examination of finished work can be greatly facilitated by the use of an improved instrument that permits fabrics, paper, metals, and the like to be compared directly with a set of controls or standards. The two images can be made to appear side by side with no dividing line in the field of its single eyepiece, or the image of the standard can be shut out and the specimen viewed in the full area of the field. Normally, the standards are mounted on a rotating disk on the lower of two stages and are turned successively until one of them corresponds with the work under scrutiny; but when the specimen to be examined is still in a machine, then the upper stage serves to hold the standard. For that purpose the supporting base of the microscope is removed. Magnification is from 15 to 210 times. A light in the housing illuminates both stages and can be focused independently on one or the other by thumb screws. The instrument is equipped to take both flat and round specimens and controls.

Potential Uses of Indium

FROM a laboratory curiosity a decade or so ago, indium, one of the rare metals, is gradually becoming a commercial product, and, together with its related elements gallium and thallium, is attracting attention because of its possible practical applications. It was discovered in 1863, and derived its name from two strong indigo-blue lines in its spectrum.

Indium is a soft white metal of low melting point—310°F.—and is present in very small quantities in many ores, especially in zincblendes. The latter rarely contain more than 0.1 per cent, but the flue dust from zinc or lead furnaces may have in it as much as 0.2 per cent. The mineral is now being recovered as a by-product in the making of zinc in Arizona and, according to recent reports, is available at a cost of about $30 an ounce, as compared with $300 some ten years ago. As a result, indium is now being produced on a commercial but limited scale, and the output will probably increase with the demand.

Present indications are that jewelers and silversmiths will be the largest potential users. Investigation has revealed that unusual color effects in jewelry can be obtained by means of indium. For example, when gold and indium are plated alternately on silver, the article becomes sky-blue when exposed to heat, while interdiffusion of layers of silver, indium, and palladium at 1,500°F. yields a fine rose-pink alloy. It has also been determined that silver-indium alloys, containing 42 per cent of indium, are desirable for the manufacture of silverware because they are immune to the attack of alkali sulphides—that is, they will not tarnish. As alloys with such a high indium content are hard and brittle, the latter is applied electrolitically, the resultant soft coating diffusing into the silver when the ware is heated.

There is a possibility that indium, in combination with Lipowitz's alloy—bismuth, lead, tin, and cadmium—may find application in the making of casts and impressions. The latter has the lowest melting point (158°F.) of the fusible alloys generally available, and with indium the metallurgists have succeeded in reducing it to as low as 116°, or to a point where it is slightly above the normal temperature of the human body. This means that the metal, consisting of 18 per cent indium and 82 per cent Lipowitz's alloy, can in the fluid state be brought in contact with the body without causing it discomfort. It is therefore not unreasonable to suppose that the day may come when it will be used instead of plaster of Paris in making casts.

Casts of this description can be rendered permanent by electroplating them with silver or copper and then melting out the fusible alloy. Cloth or blanket material impregnated with the alloy can be molded into any form when heated around 116°F. It sets rigidly upon cooling, and can be made pliable again for removal by the application of hot-water bottles.